

# **Energy & Sustainability Statement**

For

219-223 Coldharbour Lane, Loughborough Junction, London

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## 1 Introduction

This document provides a summary and statement of the predicted energy and sustainability strategy for the extension of the existing first floor to the rear and the addition of 3 floors above comprising of existing 114.5m<sup>2</sup> Class A floor space on ground floor,  $260.2m^2$  Class B1 flexible workshop/creative units on the ground floor,  $90.3m^2$  Class A and  $78.5m^2$  Class B space on first floor, including 8 Class C3 residential flats on remaining upper floors (4 x 1no. bedroom, 3 x 2no. bedroom, 1 x 3no. bedroom); provision of balconies, communal roof garden, bin stores & cycle parking; and other ancillary works at 219-223 Coldharbour Lane, located in the Borough of Lambeth.

The purpose of the report is to demonstrate how the project will seek to minimise its environmental impacts, in the context of relevant planning policy related to energy and sustainability.

This document is to be submitted to Lambeth Council as part of a full planning application.



# 2 Planning Policy

# 2.1 The London Plan Sustainable Design and Construction Supplementary Planning Guidance, March 2016-

The Supplementary Planning Guidance provides detail on the policies in the London Plan, which promote inclusive design. It sets out a framework and policies for achieving the highest standards of safe, easy and inclusive access for all people, regardless of disability, age or gender. It provides details and guidance to support developers to achieve sustainable development in line with London Plan Policy 5.3.

This section outlines the legislative policies, which have been identified to inform design decisions for the proposed development in support of this report and associated statements.

### 2.2 Lambeth Local Plan 2015

The Lambeth Local Plan 2015 is a concise, all-in-one plan setting out the vision, strategic objectives and policies for development in Lambeth over 15 years. The Plan covers housing, jobs, town centers, infrastructure, transport, environment, historic buildings and the quality of the built environment.

Together with the Mayor's London Plan it forms the statutory development plan for the borough.

### 2.2.1 Policy EN3 Decentralised Energy

States that all major developments will be expected to connect to, and where appropriate extend, existing decentralised heating, cooling or power networks in the vicinity of the site, unless a feasibility assessment demonstrates that connection is not reasonably possible.

Where networks do not currently exist, developments should make provision to connect to any planned future decentralised energy network in the vicinity of the site, having regard to opportunities identified through the London Heat Map and area specific energy plans.

### 2.2.2 Policy EN4 Sustainable Design & Construction

States that all developments, including construction of the public realm, highways and other physical infrastructure, will be required to meet high standards of sustainable design and construction feasible, relating to the scale, nature and form of the proposal.

Proposals should demonstrate in a supporting statement that sustainable design standards are integral to the design, construction and operation of the development. Non-residential



developments should also be accompanied by a pre-assessment, demonstrating how the following BREEAM standards, or any future replacement standards, will be met:

- I. All new non-residential developments and non-self-contained residential accommodation, should meet at least BREEAM 'Excellent' unless it is demonstrated that it is not technically feasible or viable to do so, in which case proposals should demonstrate a 'Very Good' rating with a minimum score of 63 per cent.
- II. All major non-residential refurbishment of existing buildings and conversions over 500m2 floor space (gross) should meet at least BREEAM Non-Domestic Refurbishment 'Excellent' unless it is demonstrated that it is not technically feasible or viable to do so, in which case proposals should demonstrate a 'Very Good' rating with a minimum score of 63 per cent.
- III. All non-residential development proposals should incorporate living roofs and walls where feasible and appropriate to the character and context of the development. Proposals should include a maintenance plan for the lifetime of the development.
- IV. Non-residential development will be required to be resilient to climate change by including appropriate climate change adaptation measures.
- V. Adequate remedial treatment of any contaminated land will be required before development can commence.

#### 2.2.3 Policy EN6 Sustainable Drainage Systems and Water Management

States that sustainable drainage systems and water management requires development proposals to demonstrate that there will be a net decrease in both the volume and rate of run-off leaving the site by incorporating sustainable drainage systems (SuDS) in line with the London Plan drainage hierarchy and National SuDS Standards to maximise amenity and biodiversity benefits and improve the quality of water discharges.



# 3 Energy Strategy – Summary

Planning policy contains guidance on following an energy hierarchy when considering reduction in CO2 emissions in major development. The energy hierarchy approach first considers incorporation of energy efficiency measures including passive design, then supplying energy efficiently (with particular emphasis on decentralised energy generation including combined heat and power) and lastly the use of renewable energy technologies.

The current proposals relate to:

"the extension of the existing first floor to the rear and the addition of 3 floors above comprising of existing  $114.5m^2$  Class A floor space on ground floor,  $260.2m^2$  Class B1 flexible workshop/creative units on the ground floor,  $90.3m^2$  Class A and  $78.5m^2$  Class B space on first floor, including 8 Class C3 residential flats on remaining upper floors (4 x 1no. bedroom, 3 x 2no. bedroom, 1 x 3no. bedroom); provision of balconies, communal roof garden, bin stores & cycle parking; and other ancillary works"

This energy statement has been produced to describe the resulting energy strategy for the proposed re-development of 219-223 Coldharbour Lane, located within the Borough of Lambeth. This statement relates to the final proposals and is submitted as part of a full planning application for the development.

#### 3.1 Energy Statement:

In accordance with Lambeth Council's policy the proposed redevelopment aspires to deliver a minimum on-site carbon dioxide emissions (CO2) reduction of 35% over Part L 2013 (design intent), where technically, functionally and economically feasible, based on the approach, information, analysis and contents reported in this document. The 35% CO2 reduction will be made up of the following anticipated key contributions:

- 1. Energy efficiency measures
- 2. Communal heating network
- 3. A centralised Air to Water Heatpump primary heating system (complete with buffer vessel)

The proposed re-development has followed the London Plan energy hierarchy and has considered incorporation of energy efficiency measures including passive design, supplying energy efficiently (with particular emphasis on decentralised energy generation and fabric first philosophy) and using renewable energy technologies. It should be noted that whilst the latest guidance from the GLA seeks a 35% CO2 reduction against the performance of the existing building, this energy statement predicts the % CO<sub>2</sub> saving beyond a 'New Build' Part L: 2013 compliant equivalent



Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

|   | Regulated domestic carbon dioxide savings |         |
|---|---|---------|
|   | (Tonnes CO <sub>2</sub> per annum)        | (%)     |
| Savings from energy demand reduction      | 2   | 23%     |
| Savings from heat network / CHP           | 0   | 0%      |
| Savings from renewable energy             | 5   | 60%     |
| Cumulative on site savings                | 6   | 84%     |
| Annual savings from off-set payment       | 1   | -       |
|   | (Tonne                                    | es CO2) |
| Cumulative savings for off-set<br>payment | 37  | -       |
| Cash in-lieu contribution (£)             | 2,238                                     |         |

The energy statement is contained in full herein in Appendix A and follows the approach to energy statements in the document 'Energy Planning - GLA Guidance on preparing energy assessments' (March 2016).

The following section contains a summary sketch of the proposed key Energy and Sustainability elements for the scheme.



## 4 Sustainability Strategy – Summary

This section formally outlines how the development will meet the objectives of the London Policy Plan 5.2 Sustainable Design and Construction, outlined in the Mayor of London's Supplementary Planning Guidance.

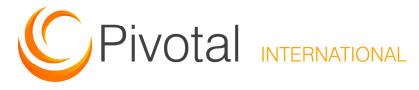
The Mayor will, and boroughs should, ensure future developments meet the highest standards of sustainable design and construction and reflect this principle in UDP or LDF policies.

These will include measures to:

- Minimise carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
- Avoiding internal overheating and contributing to the urban heat island effect
- Efficient use of natural resources (including water), including making the most natural systems both within and around buildings
- Minimising pollution (including noise, air and urban run-off)
- Minimising the generation of waste and maximising reuse or recycling
- Avoiding impacts from natural hazards (including flooding)
- Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
- Securing sustainable procurement of materials, using local supplies where feasible
- Promoting and protecting biodiversity and green infrastructure
- The guidance establishes that major developments should meet the Mayor's Priorities outlined in the Supplementary Planning Guidance. The document also set out best practice ambitions for several topic areas.
- The following table addresses each of these topic areas, identifying how the development achieves the Mayor's Priorities and where feasible the Mayor's Best Practice.



| London Plan 2016  |   |  |
|---|---|--|
| 4.1 SPG Section 2.2: Land   |   |  |
| Optimising the use of land  | Development Response  |  |
| <ul> <li>Mayor's Priorities <ol> <li>Through both their Local Plans and planning decisions, boroughs should ensure development patterns reflect the strategic spatial vision for London's growth as set out in Chapter 2 of the London Plan.</li> <li>Through both their Local plans and planning decisions, boroughs should aim for 100% of development to be delivered on previously developed land.</li> <li>Developers should optimise the scale and density of their development, considering the local context, to make efficient use of London's limited land</li> </ol> </li> </ul> | The proposed development will be sited on<br>previously developed land, located within<br>Lambeth. The site is 100% brownfield<br>and no green-field development is<br>proposed. The development will increase<br>density in line with Mayor's principle:<br><i>'Make best use of all developable land by<br/>increasing density'</i> .<br>The building design will ensure that the<br>use of floor space is optimised, balancing<br>the need to create a building with sufficient<br>floor area, whilst ensuring that the building<br>design/massing is in keeping with the<br>surrounding buildings. The design team's<br>aspiration is to create a building with a<br>high quality internal environment, with the<br>inclusion of private outdoor spaces. The<br>development proposals will provide new<br>active frontage.<br>The development is located in an area<br>with excellent public transport<br>connections which are able to support the<br>increase in density on the site. |  |
|   | There are a number of issues which have<br>been taken into account by the design<br>team when determining the height and<br>massing, and therefore density of the<br>proposed buildings. These include privacy;<br>light pollution and shadowing issues to the<br>neighboring buildings; micro-climatic<br>effects are mainly determined by<br>constraints of the existing buildings and<br>surroundings.   |  |



| Basements and Lightwells   | Development Response   |
|--|--|
| <ul> <li>Mayor's Priorities <ol> <li>When planning a basement</li> <li>development, developers should consider</li> <li>the geological and hydrological conditions</li> <li>of the site and surrounding area,</li> <li>proportionate to the local conditions, the</li> <li>size of the basement and lightwell and the</li> <li>sensitivity of adjoining buildings and uses,</li> <li>including green infrastructure.</li> </ol> </li> <li>When planning and constructing a basement development, developers should consider the amenity of neighbors. </li> <li>Mayor's Best Practice Where there is pressure for basement developments, boroughs should consider whether there are any particular local geological or hydrological issues that could particularly effect their construction and adopt appropriate policies to address any local conditions.</li></ul> |  |
| Local food growing   | Development Response   |
| <ul> <li>Mayor's Priorities <ol> <li>To protect existing established food growing spaces.</li> </ol> </li> <li>Mayor's Best Practice <ol> <li>To provide space for individual or communal food growing, where possible and appropriate.</li> </ol> </li> <li>To take advantage of existing spaces to grow food, including adapting temporary spaces for food growing.</li> </ul>   | The dwellings will be provided with high<br>quality amenity space in the form of a roof<br>garden that could give opportunity for<br>individual food growth along with private<br>balconies to upper floor residential units,<br>which is consistent with such a central<br>London location. |



| 4.2 SPG section 2.3: Site layout and design   |   |  |
|---|---|--|
| Site layout and design  | Development Response  |  |
| <b>Mayor's Priorities</b><br>1. The design of the site and building<br>layout, footprint, scale and height of<br>buildings as well as the location of<br>land uses should consider:   | Works will involve retaining the existing primary<br>building structure with refurbishment of the building<br>fabric in line with current Part L requirements.<br>Areas of soft landscaping will be incorporated via<br>the roof terrace.   |  |
| <ul> <li>Existing features the possible retention and reuse of existing buildings and structures; and the retention of existing green infrastructure, including trees and potential for its improvement and extension;</li> <li>access routes to public transport and other facilities that minimise the use of public transport;</li> <li>New design of development</li> </ul> | There are a number of issues which have been<br>taken into account by the design team when<br>determining the height and massing of the<br>proposed building. These include privacy, light<br>pollution and overshadowing issues to the<br>neighboring buildings, consideration of micro-<br>climatic effects due to wind flow, and the limitations<br>created by new and existing underground services<br>and utilities. |  |
| <ul> <li>New design of development</li> <li>the existing landform;</li> <li>the potential to take advantage of natural systems such as wind, sun and shading;</li> <li>the principles sets out London Plan policies 7.1 and 7.6;</li> <li>the potential for adaption and reuse in the future;</li> </ul>  | 219-223 Coldharbour is located within easy walking<br>distance of numerous public transport links. The<br>site is located adjacent to several bus stops with<br>main bus routes running along Coldharbour Lane.<br>The site is also within walking distance of<br>Loughborough Junction & Brixton rail stations<br>offering transport links to the North and South of<br>London.  |  |
| <ul> <li>potential for incorporating green<br/>infrastructure;</li> <li>potential for incorporating open</li> </ul>   | A Transport Statement has been produced and will form part of the overall planning submission.  |  |
| <ul> <li>space, recreation space, child<br/>play space;</li> <li>energy demands and the ability to<br/>take advantage of natural<br/>systems and low and zero carbon<br/>energy sources;</li> <li>site wide infrastructure;</li> <li>access to low carbon transport</li> </ul>  | Two Tier racks containing 4 spaces for  |  |
| <ul> <li>modes;</li> <li>potential to address any local air</li> <li>quality, noise disturbance,<br/>flooding and land contamination<br/>issues;</li> </ul>   | A Santander Cycle Hire docking station is located<br>2km to the West of the site at Stockwell<br>Underground Station.<br>At present the development strategy has  |  |
| and <ul> <li>The potential effect on the</li> </ul>   | been designed to align with current market demands in this particular area of London.   |  |
| microclimate.   | It is intended to develop the commercial  |  |



#### **Mayor's Best Practice**

Any existing buildings that can be practically refurbished, retrofitted, altered, or extended should be retained and reused

A mix of uses, where suitable should be included to provide a range of services commensurate to the public transport accessibility

areas as a shell and core for speculative market lease agreement on either single or multi tenanted basis. The retail spaces will be flexible for any incoming tenant in terms of both use and layout. Each floor has been designed as open-plan with columns positioned to enable partitioning if required, and the design of core services allows per-floor supply.

Roof 'green' terraces will increase the buildings thermal mass and decrease cooling loads whilst also absorbing heat emitted from the building, thus serving to reduce the heat island effect.

The aspiration of the design is to create a high quality simple, efficient and flexible building that will make maximum use of the natural resources available and reduce reliance on mechanical systems where possible, considering orientation, massing, thermal mass, shading, internal gains etc.

The development may experience a range of wind conditions, which are deemed generally, in keeping with the intended use of the existing and proposed site. Any areas which may be identified as having conditions outside of recommendations for outdoor use will be considered as part of the detailed design of the site.

The orientation of the building is generally Northeast-Southwest, which means that the majority of residential and commercial spaces will receive direct sunlight at some point during the day and year. Facade treatments are being selected to optimise the benefits of natural daylight into the building, whilst controlling solar gains and heat losses.

The massing of the building has been developed to ensure that the local residents retain a good level of daylighting to their properties. The issue of glare has also been considered.

For the occupants of 219-223 Coldharbour Lane and Hinton Road, glare will be reduced through



|  | <ul> <li>good façade design, glazing with good g-values and consideration of the use of internal blinds or curtains etc. Reducing the reflectivity of the glass will also be beneficial for the surrounding buildings. An adaptable façade design and glazing selection will also help to reduce the impact of unwanted solar gain, which would increase cooling loads and resulting energy consumption for the site.</li> <li>By reinvigorating the existing site, and creating a new residential and retail destination, it is hoped that the Proposed Development site can provide greater integration into the locality.</li> <li>The Proposed Development recognises that for new buildings to be considered useable for at least</li> </ul> |
|--|---|
|  | the next 60 years, a considerable level of future<br>flexibility will need to be incorporated into the<br>design.   |
|  | <ul> <li>The building environmental services strategy has been based on the need to accommodate possible future scenarios into the proposed redevelopment including:</li> <li>Advances in technology, including energy supply and conservation such as the gradual rol</li> </ul>   |
|  | <ul> <li>out of the Pimlico district network, retrofit of fuel cells, or possible bio-fuel infrastructure;</li> <li>Climate change, including the predicted increases in both external temperature and intensity of rainfall over the coming decades;</li> </ul>  |
|  | <ul> <li>Increase in transient nature of business practice</li> <li>Market sector demand;</li> <li>Requirement of different types of tenant and usage flexibility within the dwelling/use type.</li> </ul>  |
| 4.3 Energy and carb  | on dioxide emissions (SPG section 2.4)  |
| Energy and carbon dioxide<br>emissions   | Development Response  |
| Mayor's Priorities<br>1. The overall carbon dioxide<br>emissions from a development should<br>be minimised through the<br>implementation of the energy hierarchy<br>set out in London Plan policy 5.2.<br>2. Developments should be designed<br>to meet the following Regulated carbon | Appendix A below.   |
| dioxide standards, in line with London<br>Plan policy 5.2.<br>Pivotal International  | Energy Statement:<br>In accordance with Lambeth Council's policy the<br>proposed redevelopment aspires to deliver a   |



| <ul> <li>Residential buildings <ul> <li>Year Improvements beyond 2010</li> <li>Building Regulations</li> <li>1st October 2013 to 2016</li> <li>40 per cent (or 35% below 2013</li> <li>Building Regulations)</li> <li>2016 to 2031 - Zero carbon</li> </ul> </li> <li>Non-domestic buildings <ul> <li>Year Improvements beyond 2010</li> <li>Building Regulations</li> </ul> </li> <li>1st October 2013 to 2016 40 per cent (or 35% below 2013 Building Regulations)</li> <li>2016 – 2019 As per the Building Regulations)</li> <li>2016 – 2019 As per the Building Regulation requirements 2019 to 2031 Zero carbon</li> </ul> <li>Mayor's Best Practice <ul> <li>Developments should contribute to ensuring resilient energy infrastructure and a reliable energy supply, including from local low and zero carbon sources.</li> </ul> </li> <li>2. Developers are encouraged to include innovative low and zero carbon dioxide emissions within developments and keep up to date with rapidly improving technologies.</li> | <ul> <li>minimum on-site carbon dioxide emissions (CO<sub>2</sub>) reduction of 35% over Part L 2013 (design intent), where technically, functionally and economically feasible, based on the approach, information, analysis and contents reported in this document. The 35% CO<sub>2</sub> reduction will be made up of the following anticipated key contributions:</li> <li>Energy efficiency measures</li> <li>Low Temperature Centralised Communal Heating Network.</li> </ul> |
|---|--|
| Energy demand assessment  | Development Response   |
| <b>Mayor's Priorities</b><br>1. Development applications are to<br>be accompanied by an energy<br>demand assessment.  | An energy statement has been prepared to detail<br>the energy strategy for the Proposed Development<br>and is submitted as part of this energy &<br>Sustainability Statement, see Appendix A. This<br>document includes an energy demand assessment<br>following the approach to energy statements as<br>detailed in the 'Energy Planning - GLA Guidance on<br>preparing energy assessments' document.   |
| Use less energy   | Development Response   |
| Mayor's Priorities<br>1. The design of developments<br>should prioritise passive measures.  | In line with the energy hierarchy set in the<br>London Plan, the demand reducing measures set<br>out in the Energy Statement was incorporated in the   |



#### design with priority given to passive measures **Mayor's Best Practice** including the fabric first principals: 1. Developers should aim to achieve Part L 2013 Building Regulations Maximising air-tightness. requirements through design and Using Super-high insulation. energy efficiency alone, as far as is Optimising solar gain through the provision of practical. openings and shading. Optimising natural ventilation. Using the thermal mass of the building fabric. Using energy from occupants, electronic devices, cookers and so on. This delivers on the The London Plan Spatial Development Strategy (SPD). The preliminary calculations included in the Energy Statement indicate that the development is in line to surpass Part L 2013 Regulations carbon emission reduction requirements through design and energy efficiency alone. **Energy efficient supply Development Response Mayor's Priorities** Existing and planned heat networks and anchor heat loads in the vicinity of the site 1. Where borough heat maps have identified district heating opportunities. have considered for the potential boroughs should prepare more connection to the site, but no immediate detailed viable opportunities for connection were identified for the Pimlico Heat Network Energy Master Plans (EMPs) to establish the extent of market Scheme. competitive district heating networks. The Proposed Development will be served by a community heating system which enables 2. Developers should assess the potential connection to any future heat networks in the vicinity for their development to: of the site. The community heating system consist of a LTHP connect to an existing district heating Air Source Heat Pump ASHP located in a central or cooling network; plant room to supply the space heating and DHW expand an existing district heating or requirements. This novel configuration significantly cooling network, and connect to it; or decreases the circulation heat losses attributed to Establish a site wide network, and conventional hydronic communal heating systems, enable the connection of existing which typically, have a requirement of a continuous buildings in the vicinity of the loop of high temperature water supply. This system development. also beneficially alters the proportion of the DHW and space heating requirements. 3. Where opportunities arise, developers Capped off connections are proposed to the generating energy or waste heat boundary of the site enable connectivity to district or should local heat network when such an option becomes maximise long term carbon dioxide



| savings by feeding the decentralised<br>energy network with low or zero<br>carbon<br>hot water, and where required, cold<br>water.  | available and viable.   |
|---|---|
| 4.4 Renewab   | energy (SPG section 2.5)  |
| Renewable energy  | Development Response  |
| <ul> <li>Mayor's Priorities</li> <li>1. Boroughs and neighborhoods<br/>should<br/>identify opportunities for the<br/>installation<br/>of renewable energy technologies in<br/>their boroughs and neighborhoods.</li> <li>2. Major developments should<br/>incorporate renewable energy<br/>technologies to minimise overall<br/>carbon dioxide emissions, where<br/>feasible.</li> </ul>  | A feasibility study has been undertaken to<br>determine what is deemed the most appropriate<br>renewable energy source for the development (for<br>more details please refer to the Energy Statement<br>included in Appendix A herein).<br>The integration of living roof and PV panels to<br>create a bio-solar roof is proposed for the<br>development. The PV array will provide renewable<br>electricity to the development. The PV layout has<br>made use of the available roof area limited due to<br>the form and massing of the building whilst<br>providing consideration to the application of a roof<br>terrace and local screened plant area and parapet. |
| Carbon dioxide off-setting  | Development Response  |
| <ul> <li>Mayor's Priorities <ol> <li>Boroughs should establish a carbon dioxide off-set fund and identify suitable projects to be funded.</li> <li>Where developments do not achieve the Mayor's carbon dioxide reduction targets set out in London Plan policy 5.2, the developer should make a contribution to the local borough's carbon dioxide off-setting fund</li> </ol></li></ul> | The current energy prediction results in the site wide 82% CO <sub>2</sub> savings target being achieved and as such is expected to make an offset payment in accordance with London Plan Policy 5.2. The remaining regulated carbon dioxide emissions savings to 100 per cent provided by way of a carbon offset financial contribution, based on £95 per tonne. Refer to the CO2 calculation tables below in for contribution amount.   |



| Retrofitting  | Development Response   |
|---|--|
| <ul> <li>Mayor's Priorities</li> <li>1. Boroughs should set out policies to encourage the retrofitting of carbon dioxide and water saving measures in their borough.</li> <li>2. Where works to existing</li> </ul> | The proposed design will incorporate CO <sub>2</sub> and water savings measures as detailed elsewhere in this document.  |
| developments are proposed<br>developers should retrofit carbon<br>dioxide and water saving measures.  |  |
| Monitoring energy use   | Development Response   |
| <b>Mayor's Priorities</b><br>1. Developers are encouraged to<br>incorporate monitoring equipment<br>and systems where appropriate to<br>enable occupiers to monitor and<br>reduce their energy use.                 | Extensive submetering will be present to<br>allow monitoring as well as separate<br>billing of individual tenancies.<br>Energy display devices will be provided in the<br>dwellings in line with the equivalent requirement of<br>the deregulated Code for Sustainable Homes<br>criteria.                              |
| Supporting a resilient energy supply  | Development Response   |
| <b>Mayor's Priorities</b><br>1. Developers are encouraged to<br>incorporate equipment that would<br>enable their schemes to participate in<br>demand side response opportunities.                                   | The proposed development overall energy<br>demand has been minimised through the<br>implementation of the sustainable design<br>measures outlined in this statement; this<br>will reduce overall impact on the wider<br>energy network.  |
|   | The development will also be provided with<br>comprehensive sub-metering and smart meters to<br>allow better management of the energy demand and<br>better response to wider network energy availability<br>through the central BMS system.  |
| 4.5 Water efficiency (SPG section 2.6)  |  |
| Water efficiency  | Development Response   |
| Mayor's Priorities<br>1. Developers should maximise the<br>opportunities for water saving<br>measures and appliances in all<br>developments, including the reuse<br>and using alternative sources of<br>water.      | <ul> <li>The re-development recognises that the threat of future water shortage is a serious issue for London.</li> <li>Water efficiency and recycling has been made a key priority in the design by incorporating the following water efficiency elements:</li> <li>Reduce mains water consumption on site</li> </ul> |



| 2. Developers should design<br>residential schemes to meet a water<br>consumption rate of 105 litres or less<br>per person per day.   | <ul> <li>Reuse water on site where possible thus reducing water to sewerage</li> <li>Specify water efficient internal sanitary ware and appliances</li> </ul>   |
|---|---|
| <ul><li>3. Where a building is to be retained, water efficiency measures should be retrofitted.</li><li>4. New per residential</li></ul>  | The target water consumption for residential<br>dwellings is 105 litres/person/day and the<br>combination of relevant measures herein will enable<br>credits to be targeted for the BREEAM  |
| 4. New non-residential developments, including refurbishments, should aim to  | assessment.   |
| achieve the maximum number of<br>water credits in a BREEAM  | All individual dwellings as well as commercial units will be separately metered.  |
| assessment or the 'best practice'<br>level of the AECB (Association of<br>Environment Conscious Building)<br>water standards.   | Methods to Reduce Consumption and<br>Wastage:<br>Proximity detection water shut-off using<br>infra-red presence detection monitors  |
| 5. All developments should be designed to incorporate rainwater harvesting.   | (PIRs) will ensure that when the toilet and<br>shower areas are not in use, there is no<br>risk of water leakage. This will be applied<br>to non-residential areas.   |
| <b>Mayor's Best Practice</b><br>6. All residential units, including<br>individual flats / apartments and<br>commercial units, and where<br>practical, individual leases in large<br>commercial properties should be | Pulsed output water meters will be installed at the<br>site boundary and the building entry points to provide<br>leak detection between the buildings and site<br>boundary, as well as for monitoring large<br>water uses in the building. All nondomestic and<br>domestic units will have individual water meters. |
| metered.  | Water Saving Devices:<br>The following range of water efficient   |
|   | measures have been incorporated into the design to reduce water consumption   |
|   | Dual flush WCs  |
| commercial properties should be   | Water Saving Devices:<br>The following range of water efficient<br>measures have been incorporated into the<br>design to reduce water consumption<br>demand:  |



| 4.6 Materials and waste (SPG section 2.7)  |   |  |
|--|---|--|
| Design phase   | Development Response  |  |
| Mayor's Priorities 1. The design of development should prioritise materials that: have a low embodied energy, including those that can be reused intact or recycled - at least three of the key elements of the building envelope (external walls, windows roof, upper floor slabs, internal walls, floor finishes / coverings) are to achieve a rating of A+ to D in the BRE's <i>The Green Guide</i> of specification; can be sustainably sourced - at least 50% of timber and timber products should be sourced from accredited Forest Stewardship Council (FSC) or Programme for the Endorsement of forestry Certification (PEFC) source; are durable to cater for their level of use and exposure; and Will not release toxins into the internal and external eenvironment, including those that deplete stratospheric ozone. Mayor's Best Practice 1. The design of developments should maximise the potential to use prefabrication elements. | <ul> <li>Where new materials are required:<br/>Materials will be chosen that have a minimal<br/>environmental impact, are from sustainable or<br/>recycled sources and, where feasible, are locally<br/>sourced to reduce transportation impacts,<br/>prioritising the following factors:</li> <li><i>Life cycle costing (£ and CO2)</i></li> <li><i>Use renewable materials</i></li> <li><i>Source materials locally</i></li> <li><i>Recycled content</i></li> <li><i>Minimise waste to landfill</i></li> <li><i>Specification of materials with zero exotoxins</i></li> <li><i>Synthetic or non-sustainably-sourced materials<br/>to be minimised</i></li> <li>Off-site manufacturing</li> <li><i>Ethical sourcing</i></li> <li><i>Minimise embodied energy</i></li> <li><i>Design for Disassembly</i></li> <li><i>Recycled july of materials</i></li> <li><i>Design mechanical fixings to facilitate<br/>deconstruction</i></li> <li><i>Specify materials and plant that can be re-used</i></li> <li><i>Lowest available embodied carbon option MEP<br/>Materials Specification</i></li> <li><i>Minimise gluing and composite materials</i></li> <li>The project team will target the use of materials<br/>selected in accordance with The Green Guide to<br/>Specification, a measure of environmental impact of<br/>the material over its lifetime. The selection of A+<br/>and A-rated materials will be prioritised and feed in<br/>to the BREEAM credit scores.</li> <li>The team will endeavor to use structural<br/>timber from FSC compliant sources. The team will<br/>also endeavor to use non-structural timber from a<br/>known source with a sustainable purchasing policy,<br/>and not be included on the CITES (Convention on<br/>International Trade in Endangered Species) list.</li> <li>Insulation materials for building elements and<br/>building services will be specified with low<br/>embodied environmental impact (minimal global<br/>warming potential and zero ozone depleting<br/>properties). The opportunity to source construction</li> </ul> |  |



|   | <ul> <li>materials from a factory/plant, quarry, railhead or recycling centre close of the site will be investigated, with priority given to use of prefabricated elements, where feasible. Locally sourced aggregates and durable materials will be emphasised in the hard landscaping, where feasible.</li> <li>The Institute of Civil Engineers (ICE) Demolition Protocol will be followed to ensure that the potential for reusing and recycling the materials currently on site will be maximised. A full survey will be undertaken to review where materials can be reused on site e.g. aggregates, and if they can't be used, where they can be recycled as locally as possible.</li> <li>No peat or weathered limestone is to be used in either the buildings or landscaping. The Waste &amp; Resources Action Programme (WRAP) toolkit will be used at design stage to assess how use of recycled and reused materials can be maximised.</li> <li>The development will aim to maximise the proportion of materials and components that can be re-used at the end of the building's life. 'Designing for robustness' will ensure that damage to the building due to wear and tear, for example in areas of heavy usage, is minimised and can be repaired with minimal environmental or cost impact</li> </ul> |
|---|---|
| Construction phase  | Development Response  |
| <b>Mayor's Priorities</b><br>1. Developers should maximise the<br>use of existing resources and<br>materials and minimise waste<br>generated during the demolition and<br>construction process through the<br>implementation the waste hierarchy. | <ul> <li>The development aims to be a sustainable building with high standards of environmental performance. As such, due consideration is given to the waste generated by the buildings during all phases of the development from site enabling works, during its operation and through to its eventual decommissioning. As a result, the waste strategy has the following aims:</li> <li>To contribute towards achieving current and long-term government GLA and City of Westminster targets for waste minimisation, recycling and reuse.</li> <li>To ensure that all legal requirements for the handling and management of operational waste are complied with</li> <li>To provide tenants with a convenient, clean and efficient waste management systems that</li> </ul>  |



|                       | enhance the operation of the building and promote high levels of recycling.   |
|-----------------------|---|
|                       | The following points are key to the design and construction of the project:   |
|                       | <ul> <li>During Construction:</li> <li>Site wide waste management plan</li> <li>Opportunities for prefabrication</li> <li>Recycling target</li> <li>Site travel efficiency</li> </ul>   |
|                       | <ul> <li>During Operation:</li> <li>Sufficiently sized and centralised space for recycling collection</li> <li>Compactors</li> <li>Minimise volume of waste to landfill</li> </ul>  |
|                       | The principle contractor will have responsibility for<br>writing, implementing and updating the Site Waste<br>Management Plan (SWMP) throughout the<br>development process. The SWMP will identify all<br>waste streams and will discuss the potential to<br>reduce, re-use, and recycle all materials wherever<br>possible.  |
|                       | <ul> <li>This commitment to minimisation will be achieved in a number of ways, including but not limited to, the following:</li> <li>Agreements with material suppliers to reduce the amount of packaging or to participate in a packaging take back scheme Implementation of a 'Just in Time' material delivery system to avoid materials being stockpiled on site for long periods of time, which increases risk of damage and disposal as waste</li> <li>Attention to material quantity requirements to avoid over ordering and generation of waste materials</li> <li>Re-use of materials wherever feasible</li> <li>Segregation of waste at source where practical</li> <li>Re-use and re-cycling of materials off-site where re-use on-site is not practical</li> </ul> |
|                       | Modular construction / off site prefabrication will be considered delivering benefits: see Appendix 7.1   |
|                       | Recycling collection facilities will be implemented in<br>the building within Ground Floor refuse stores. All<br>waste will be collected from Coldharbour Lane.   |
| Pivotal International | 20  |



| Occupation phase   | Due to the nature of the existing site<br>where applicable the Institute of Civil<br>Engineers (ICE) Demolition Protocol will<br>be followed to ensure that the potential for<br>reusing and recycling the materials currently on site<br>will be maximised. A full survey will be undertaken<br>to review where materials can be reused on site<br>e.g. aggregates, and if they can't be used,<br>where they can be recycled as locally as<br>possible.<br>Development Response |  |
|--|--|--|
| <ul> <li>Mayor's Priorities</li> <li>1. Developers should provide<br/>sufficient internal space for the<br/>storage of recyclable and<br/>compostable materials and waste in<br/>their schemes.</li> <li>2. The design of development should<br/>meet borough requirements for the<br/>size and location of recycling,<br/>composting and refuse storage and<br/>its removal.</li> </ul> | Recycling facilities will be implemented in the<br>building. Separate residential and commercial<br>waste stores will be provided at ground level, each<br>with separate bins for general waste and<br>recyclables.<br>Commercial bin store includes a compactor with<br>1280I Eurobins and the remainder bin stores with<br>1280I Eurobins only to meet Lambeth Council's<br>Waste & Recycling Storage & Collection<br>Requirements (Oct 2013)                                  |  |

| Nature conservation and biodiversity   | Development Response   |
|--|--|
| <ul> <li>Mayor's Priorities <ol> <li>There is no net loss in the quality and quantity of biodiversity.</li> </ol> </li> <li>Developers make a contribution to biodiversity on their development site.</li> </ul> | Due to the constraints of the existing site<br>the landscaping scheme is limited although where<br>feasible and identified will be developed to<br>maximise ecological improvement and provide<br>environmental benefit, with particular focus given in<br>the following areas:<br>Terraces within the development will ensure that<br>there will be a net gain in terms of biodiversity on<br>the site. The site has currently low ecological value<br>and therefore proposed improvements will result on<br>a significant improvement on the biodiversity of the<br>site. Where feasible, vegetation to be planted on<br>the site will have a low water requirement (low<br>maintenance native species and drought resistant<br>species will be specified) and will be selected to |
|  | improve the habitat for local wildlife and birds.<br>Planting species will be found on the London<br>Biodiversity Action Plan.   |
| 4.8 Tackling increase temperature and drought (SPG section 3.2)  |  |
| Overheating  | Development Response   |
| Pivotal International  | 21   |



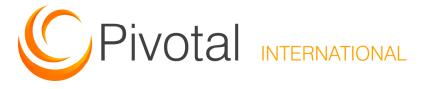
| Mayor's Priorities<br>1. Developers should include<br>measures, in the design of their<br>schemes, in line with the cooling<br>hierarchy set out in London Plan<br>policy 5.9 to prevent overheating<br>over the scheme's lifetime. | An adaptable façade design and self-shading<br>ability plus glazing selection has been deployed on<br>the scheme to help reduce the impact of unwanted<br>solar gain, which would otherwise increase cooling<br>loads and hence energy consumption in the<br>building, whilst encouraging daylight and providing<br>views. |  |
|---|--|--|
| Mayor's Best Practice<br>1. The design of developments<br>should prioritise landscape planting<br>that is drought resistant and has a<br>low water demand for<br>supplementary watering.  |  |  |
| Resilient foundations   | improve the habitat for local wildlife and birds. Development Response   |  |
| Mayor's Best Practice 1. Developers should consider any long term potential for extreme weather   | <ul><li>The site does not propose any new trees<br/>and new foundations will be incorporated as part of<br/>the overall proposal.</li><li>Any new trees considered will be above ground<br/>floor, so can be planted within tree pits which<br/>would create the root barriers.</li></ul>                                  |  |
| events to affect a building's foundations and to ensure they are robust.  |  |  |



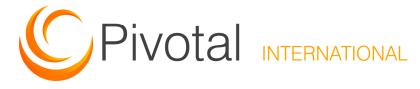
| 4.9 Increasing green cover and trees (SPG section 3.3)  |   |  |
|---|---|--|
| Urban greening  | Development Response  |  |
| Mayor's Priorities<br>1. Developers should integrate<br>green<br>infrastructure into development<br>schemes, including by creating links<br>with wider green infrastructure<br>network. | Opportunities for incorporation of green<br>areas have been maximised despite the<br>development being in a dense urban location and<br>constrained by the existing site and building.<br>Additional green coverage will be provided with the<br>incorporation of strategically located planters and<br>soft landscaping. This will be in excess of 5%<br>increase as the existing development has very |  |
| 2. Major developments in the<br>Central London Activity Area (CAZ)<br>should be designed to contribute to<br>the Mayor's target to increase green<br>cover by 5% in this zone by 2030.  | limited green areas.  |  |
| Trees   | Development Response  |  |
| Mayor's Priorities 1. Developments should contribute to the   | There is no loss of trees anticipated in the development.   |  |
| Mayor's target to increase tree cover across London by 5% by 2025.  | Additional tree coverage is restricted by virtue of the existing site and building.   |  |
| 2. Any loss of a tree/s resulting from development should be replaced with  | New trees indicated on planning drawings which will be subject to conditions  |  |
| an appropriate tree or group of trees<br>for<br>the location, with the aim of   |   |  |
| the same canopy cover as that<br>provided   |   |  |
| by the original tree/s.   |   |  |



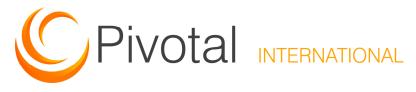
| 4.10 Flooding (SPG section 3.4)  |   |  |
|--|---|--|
| Surface water flooding and sustainable drainage  | Development Response  |  |
| <ul> <li>Mayor's Priorities</li> <li>1. Through their Local Flood Risk<br/>Management Strategies boroughs<br/>should identify areas where there are<br/>particular surface water management<br/>issues and develop policies and actions<br/>to address these risks.</li> <li>2. Developers should maximise all<br/>opportunities to achieve greenfield<br/>runoff rates in their developments.</li> <li>3. When designing their schemes<br/>developers should follow the drainage</li> </ul> | A Flood Risk Assessment has been<br>undertaken for the site.<br>This includes data which confirms that the<br>site is at very low risk of surface water<br>flooding and that there are no records of the<br>site having flooded in the past due to sewer<br>flooding.<br>Existing sewers would continue to be used<br>to convey the majority of surface runoff<br>from the site.<br>Otherwise, the Proposed Development |  |
| <ul> <li>hierarchy set out in London Plan policy</li> <li>5.13</li> <li>4. Developers should design Sustainable<br/>Drainage Systems (SuDS) into their<br/>schemes that incorporate attenuation<br/>for surface water runoff as well as<br/>habitat, water quality and amenity<br/>benefits.</li> </ul>  | does not represent a significant change to<br>the runoff characteristics of the site.<br>In view of the scale and context of the<br>construction works (redevelopment largely<br>comprises internal reconfiguration and<br>changes to the facades and would take<br>place entirely within the existing built<br>footprint), the significant amount of work<br>required to achieve further reductions in                 |  |
|  | runoff through other SUDS is not<br>considered to be justified.   |  |
| Flood resilience and resistance of<br>buildings in floor risk areas  | Development Response  |  |
| Mayor's Priorities<br>1. Development in areas at risk from any<br>form of flooding should include flood<br>resistance and resilience measures in<br>line with industry best practice   | The site is located in Flood Zone 1<br>Even in the very unlikely occurrence of<br>flooding in Coldharbour Lane a flooding<br>depth of 250 mm would only lead to a<br>depth of flooding above kerb height of<br>approximately 100 mm and would be very<br>unlikely to rise above FFLs.   |  |



| Flood risk management   | Development Response   |  |
|---|--|--|
| <ul> <li>Mayor's Priorities <ol> <li>Developments are designed to be flexible and capable of being adapted to and mitigating the potential increase in flood risk as a result of climate change.</li> <li>Developments incorporate the recommendation of the TE2100 plan for the future tidal flood risk management in the Thames estuary</li> <li>Where development is permitted in a flood risk zone, appropriate residual risk management measures are to be incorporated into the design to ensure resilience and the safety of occupiers.</li> </ol> </li> </ul> | The design of the proposed development<br>has included the potential for climate<br>change increases in flood risk. As a result of<br>the Thames Tidal Defenses, there is not<br>predicted to be any flooding of the site even<br>in the event of climate change-induced<br>increases in flood levels over the next 100<br>years.<br>Measures to address residual flood risks<br>have been incorporated in the design as<br>described above. |  |
| Flood defenses  | Development Response   |  |
| <ul> <li>Mayor's Priorities</li> <li>1. Development should maximise all opportunities to achieve an 8m setback on fluvial watercourses between built development and watercourses, flood defenses and culverts.</li> <li>2. Development should maximise all opportunities to achieve a 16m setback on tidal watercourses between built development and watercourses and flood defenses.</li> </ul>  | The proposed development is at a significantly greater distance than 16 m from any watercourse or flood defense.   |  |
| Other sources of flooding   | Development Response   |  |
| <b>Mayor's Priorities</b><br>1. All sources of flooding need to be<br>considered when designing and<br>constructing developments.   | The design has considered all sources of flooding.   |  |



| 4.11 Land contamination (SPG section 4.2)  |  |  |
|--|--|--|
| Land contamination   | Development Response   |  |
| <b>Mayor's Priorities</b><br>1. Developers should set out how<br>existing land contamination will be<br>addressed prior to the commencement<br>of their development.   | No land contamination is expected on site.<br>Proposed uses do not represent high<br>polluting risk.   |  |
| 2. Potentially polluting uses are to incorporate suitable mitigation measures.   |  |  |
| 4.12 Air pollu   | ition (SPG section 4.3)  |  |
| Air pollution  | Development Response   |  |
| <ul> <li>Mayor's Priorities <ol> <li>Developers are to design their schemes so that they are at least 'air quality neutral'.</li> <li>Developments should be designed to minimise the generation of air pollution.</li> <li>Developments should be designed to minimise and mitigate against increased exposure to poor air quality.</li> <li>Developers should select plant that meets the standards for emissions from combined heat and power and biomass plants set out in Appendix 7.</li> <li>Developers and contractors should follow the guidance set out in the emerging minimising dust and emissions from construction and demolition SPG when constructing their development.</li> </ol> </li> </ul> | <ul> <li>The following factors have been taken into account within the design:</li> <li>Minimise NOx emissions Carbon filters fitted to MVHR systems Reduction of traffic to site by providing cycling facilities.</li> <li>Plant and machinery will be designed to incorporate a maintenance strategy. This will ensure plant is easily accessible and recommendations for a regular service agreement will be put in place. Regular maintenance and inspection of plant can avoid adverse health impacts, by maintaining operational efficiency and minimizing harmful emissions.</li> <li>A Transport Statement has been produced to assess the transport impact of the proposed development. The following long stay cycle parking has been provided at basement level which meets London Plan 2015 standards: <ul> <li>Two Tier racks containing 4 spaces for Shop/Office occupants</li> <li>Two Tier racks containing 19 spaces for residential use</li> </ul> </li> </ul> |  |
|  | at Stockwell Underground Station.<br>KPIs will be set to monitor and reduce<br>impacts of construction works, including air  |  |



|  | pollution, energy and water use, and construction vehicle traffic.  |  |
|--|---|--|
| 4.13 Noise (SPG section 4.4)   |   |  |
| Noise  | Development Response  |  |
| <ul> <li>Mayor's Priorities <ol> <li>Areas identified as having positive sound features or as being 'quiet areas' should be protected from noise enhanced, where possible.</li> <li>Noise should be reduced at source and then designed out of a scheme to reduce the need for mitigation measures.</li> </ol></li></ul> | The following factors have been prioritised<br>within the design in order to reduce the<br>impact of noise produced within the<br>development, and minimise the negative<br>effect of noise sources arising outside the<br>building:<br>• Optimise deliveries and timings<br>• Attenuation of noise to and from the site<br>• Location in relation to noise sensitive<br>environments<br>• Reduction of traffic to site by providing<br>cycling facilities<br>The local acceleration and breaking of<br>traffic on surrounding roads creates noise<br>and airborne pollution.<br>Noise surveys have been undertaken on the<br>site and concluded that suitable noise levels<br>can be achieved using appropriate façade<br>treatment through insulation, glazing and<br>ventilation arrangements.<br>An initial facade sound insulation<br>assessment has been carried out to<br>determine the required acoustic<br>performance of the facade in order to<br>achieve indoor ambient noise levels as set<br>out by the relevant guidance, and provide<br>guidance on the ventilation strategy. This<br>has informed the design of the facade and<br>associated Building Services.<br>For residential dwellings, the proposed<br>design intent is to improve on Building<br>Regulations (2003) Part E for internal sound<br>transmission standards by 5dB.<br>Furthermore, people will be encouraged to<br>take public transport or cycle to the<br>development, which will contribute towards<br>reducing the local sound and air pollution<br>levels by reducing traffic to the site. |  |



#### Deliveries to site will be coordinated and optimised to limit the noise and traffic impact on local residents. 4.14 Light pollution (SPG section 4.5) Light pollution **Development Response Mayor's Priorities** Light pollution will be minimised by 1. Developments and lighting schemes considerate selection of external light should be designed to minimise light fittings to avoid light spillage as well as time clock and dusk-to-dawn controls. pollution. 4.15 Water pollution (SPG section 4.6) Surface water runoff **Development Response Mavor's Priorities** The Proposed Development 1. In their aim to achieve a greenfield does not represent a significant change to the runoff characteristics of the site. runoff rate developers should incorporate sustainable urban drainage systems (SuDS) into their schemes Best practice water management and which also provide benefits for water pollution control will be employed during quality. construction. **Mayor's Best Practice** 2. Encourage good environmental practice to help reduce the risk from business activities on the London water environment. 3. Encourage those working on demolition and construction sites to prevent pollution by incorporating prevention measures and following best practice. Water treatment **Development Response** Mayor's Best Practice The development will be connected to the 1. Residential developments discharging public foul sewer. domestic sewage should connect to the public foul sewer or combined sewer network where it is reasonable to do so. 2. Commercial developments discharging trade effluent should connect to the public foul sewer or combined sewer network where it is reasonable to do so subject to a trade



| effluent consent from the relevant sewerage undertaker.  |
|--|
| 3. Developments should be properly connected and post-construction checks should be made by developers to ensure that misconnections do not occur. |



# 5 BREEAM

The aim of BREEAM is to estimate the environmental impact of buildings. Lambeth Local Plan 2015 EN4 Sustainable Design & Construction requires;

 All major non-residential refurbishment of existing buildings and conversions over 500m2 floorspace (gross) should meet at least BREEAM Non-Domestic Refurbishment 'Excellent' unless it is demonstrated that it is not technically feasible or viable to do so, in which case proposals should demonstrate a 'Very Good' rating with a minimum score of 63 per cent.

As the non-residential refurbishment area is less than the specified 500m2, a BREEAM Non-Domestic Refurbishment assessment has not taken place.



# Appendix A

# 1 Energy Statement:

This energy statement has been produced to describe the resulting energy strategy for the proposed development of 219-223 Coldharbour Lane, located within the Borough of Lambeth.

This statement relates to the final proposals and is submitted as part of a full planning application for the redevelopment.

In accordance with WCC policy the proposed redevelopment aspires to deliver a minimum on-site carbon dioxide emissions (CO<sub>2</sub>) reduction of 35% over Part L 2013 (design intent), where technically, functionally and economically feasible, based on the approach, information, analysis and contents reported in this document. The 35% CO<sub>2</sub> reduction will be made up of the following anticipated key contributions:

- Energy efficiency measures
- Communal heating network via ASHP central plant

The proposed development is made up of a material change of use from Sui Generis and Retail Spaces to Office & Retail spaces, located across ground and first floor levels, with 8 residential units over first floor. The proposed development has followed the London Plan energy hierarchy and has considered incorporation of energy efficiency measures including passive design, supplying energy efficiently (with particular emphasis on fabric first principals and communal space and DHW heating system) and using renewable energy technologies. It should be noted that whilst the latest guidance from the GLA seeks a 35% CO<sub>2</sub> reduction against the performance of the existing building, this energy statement predicts the % CO<sub>2</sub> saving beyond a 'New Build' Part L: 2013 compliant equivalent building.



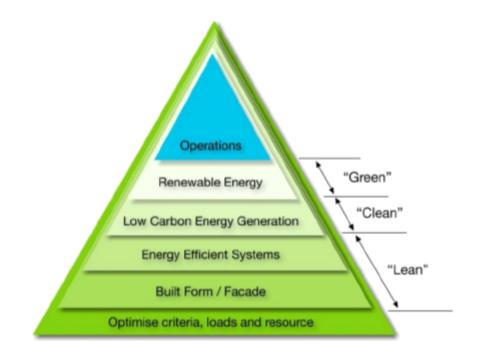
# 2 Introduction

This Energy Statement demonstrates how the proposed development addresses the energy policy requirements of Lambeth Council and the Mayor of London, in particular the Lambeth Local Plan 2015, the Greater London Authority (GLA) London Plan, and the GLA Supplementary Planning Guidance (SPG) on Sustainable Design and Construction. The report addresses the assessment process and the estimated CO2 savings achieved through integration of passive design, energy efficiency measures and Low and Zero Carbon (LZC) technologies.

The approach taken for the energy assessment is in line with Greater London Authority (GLA) planning policy for energy:

- 'Be Lean' A review of the energy efficient measures incorporated to reduce energy demand (form, building fabric and building services);
- 'Be Clean' Investigation of the feasibility of CHP/CCHP for the site;
- 'Be Green' An assessment of the feasibility of a range of low and zero carbon technologies for the site;
- Predicted performance against policy targets.

The project team has developed a holistic approach to energy and carbon performance, expanding on the Mayor's Energy Hierarchy. This approach is designed to reduce energy consumption and related CO<sub>2</sub> emissions in the first instance before considering how energy is to be supplied, as per methodology illustrated below.





Each step in the Energy Hierarchy has been followed and carbon savings quantified separately for the 'Lean', 'Clean' and 'Green' scenarios within this statement.

Baseline Energy Consumption & CO<sub>2</sub> Emissions

The strategy considers a Part L 2013 compliant baseline. In order to determine predicted energy and  $CO_2$  figures for dwellings a representative selection of residential units has been modeled using STROMA software, according to the SAP methodology as per Building Regulations Part L requirement.

In order to determine predicted energy and CO<sub>2</sub> figures for the non-domestic areas of the proposed re-development these have been modeled using Integrated Environmental Solutions (IES), Virtual Environment 2014 software. This software calculates the Building CO<sub>2</sub> Emissions Rate (BER) and Notional Target Emission Rate (TER) using the Building Regulations methodology based on the National Calculation Methodology (NCM).

#### 2.1 Baseline Scheme: CO<sub>2</sub> Emissions

Carbon emission factors are based upon the revised SAP10 published figures:

| Gas                        | 0.216 | kgCO <sub>2</sub> /kWh |
|----------------------------|-------|------------------------|
| Grid Supplied Electricity  | 0.233 | kgCO <sub>2</sub> /kWh |
| Grid Displaced Electricity | 0.233 | kgCO <sub>2</sub> /kWh |

# 3 Impact of Passive Design & Energy Efficiency Measures

A key element of the energy strategy has been to maximise the energy efficiency of the building, through passive design and efficient servicing. A summary of the proposed fabric and glazing specification for each area of the development is contained within the tables below:

| Element                      | Dwellings               | Commercial areas        |
|------------------------------|-------------------------|-------------------------|
| External Wall U-Value        | 0.15 W/m <sup>2</sup> K | 0.2 W/m <sup>2</sup> K  |
| Roof                         | 0.11 W/m <sup>2</sup> K | 0.15 W/m <sup>2</sup> K |
| Ground Floor                 | n/a                     | 0.18 W/m <sup>2</sup> K |
| Window incl. frame U-Value   | 0.73 W/m <sup>2</sup> K | 1.4 W/m <sup>2</sup> K  |
| Glazing g-value              | 0.63                    | 0.63                    |
| Air permeability (dwellings) | 3 m³/hr/m² @ 50Pa       | 10 m³/hr/m² @ 50Pa      |

The above target building envelope performance values are applicable to the provision, renovation and retention of thermal elements of the proposed redevelopment.



As part of the holistic and integrated design development process, on-going studies will be carried out through detailed design to ensure the optimum façade and building envelope solution is carried forward i.e. the solution considered to provide the best result in terms of predicted: energy consumption, CO<sub>2</sub> emissions and thermal and visual comfort.

The following energy efficiency measures within the building services systems are proposed for the development:

- LTHW Air Source Heat Pump Central Heating plant linked to BMS and include central time control, weather compensation and metering
- Comfort cooling to Retail areas available from high efficiency heatpump units;
- All areas to be fitted with high efficiency lighting. Non-residential areas are anticipated to have time based PIR detectors with PIR/daylight sensing to perimeter zones, where feasible;
- Energy display devices are assumed to be installed monitoring electricity and primary heating fuel to each dwelling;
- Retail areas are to be Shell and Core and will be provided with capped connections to the central heating/cooling systems and domestic hot water to enable future fit out by incoming tenants / operators;
- Energy performance standards for future fit-outs have been assumed for this assessment, including energy efficient general lighting, display lighting, lighting controls, and energy efficient ventilation. A form of green fit-out guidance will be provided to incoming tenants by the Client to detail the fit-out energy performance standards required to deliver the CO<sub>2</sub> savings predicted in this energy strategy;
- Residential ventilation supplied from Mechanical Ventilation Heat Recovery units (MVHR) with low specific fan power and highly efficient heat recovery;
- Variable Speed Drives for pumps and fans will be installed;
- Enhanced pipework and ductwork thermal insulation;
- Measures to reduce water consumption within the building via water efficient fittings and grey water recycling will have an impact on the energy consumption. A reduction in water consumption should result in reduced energy demand due to the reduction in electricity required to pump water, and reduction in energy for heating the domestic hot water (DHW) supply.

Whilst these are the design standards currently targeted, their achievability will be reviewed through detailed design stages to mitigate the risk of not achieving the overall CO<sub>2</sub> reduction targets, and to take into account any design changes.



# 4 Assessment of Low Carbon Technologies

The second stage of the Lean, Clean, Green methodology concerns low-carbon energy ('Clean' solutions) and considers decentralised energy generation, including combined heat and power (CHP).

The following opportunities have been assessed within the development:

- Connection to existing heat networks beyond the site boundary
- Connection to existing low carbon heat distribution networks including combined heat and power (CHP)
- Providing a site-wide heating network including combined heat and power (CHP)

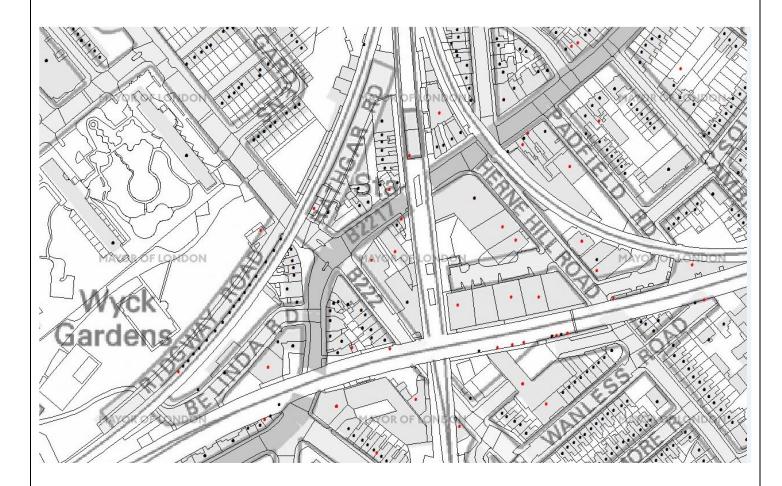
The feasibility study determined a CHP would not be the optimum solution for this development for the flowing reasons:

- The centralised LTHW Heat pump system delivered higher CO<sub>2</sub> reductions when modelled against the CHP as there were less distribution losses and reduced demand.
- The Clean Air Strategy published in March has set stringent targets to cut emissions by 2020 and 2030. The goal is to reduce the harm to human health from air pollution by. It indicates CHP engines should only be used where no adverse effect on air quality can be demonstrated.
- A development of under 300 units is now considered as unviable for a CHP given the above considerations and the deployment of the Fabric First principal which reduces the onsite demand of a building.



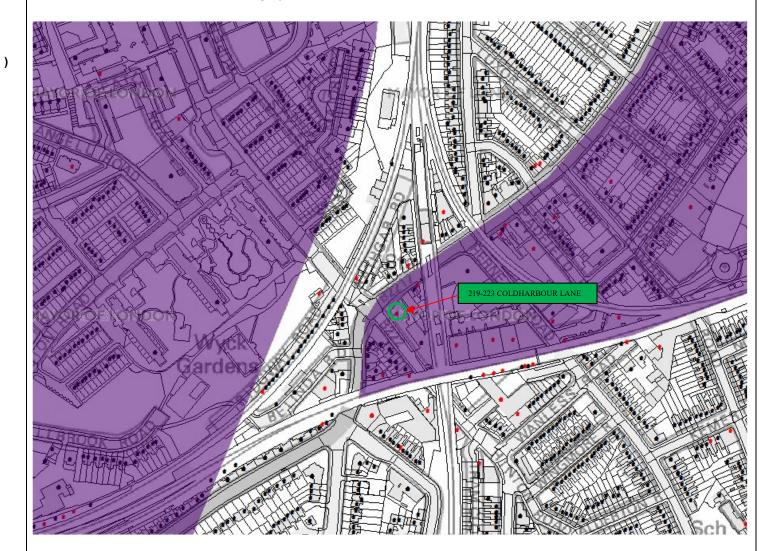
#### 4.1 Connection to Existing Heat Network

219-223 Coldharbour Lane is marked with a green circle in the extract from the London Heat Map diagram below. The London Heat Map indicates there are no existing heat networks in the immediate economically viable vicinity of the site.





The area does however fall within future opportunities area as highlighted in purple from the London Heat Map. Connections will be made available within the plant room to take future connection s of district heating system when it becomes available.





#### 5 Assessment of Renewable Technologies

A feasibility study has been carried out to establish the most appropriate local LZC energy source for the building. The study has assessed the natural resources available on site, and analysed the feasibility of each LZC energy source against the building's energy demands.

The following LZC technologies are identified within both the London Plan and BREEAM credit guidance. These technologies have been considered for application for 219-223 Coldharbour Lane Development.

| Technology  | Y/N | Viability   |  |  |  |  |  |  |  |  |
|---|-----|---|--|--|--|--|--|--|--|--|
| Solar thermal   | N   | Conflicts with CHP  |  |  |  |  |  |  |  |  |
| Solar photovoltaic  | Y   | Appropriate   |  |  |  |  |  |  |  |  |
| Wind turbines   | N   | <ul> <li>Location, noise and vibration<br/>issues</li> </ul>  |  |  |  |  |  |  |  |  |
| <ul> <li>Biomass single room<br/>heaters/stoves</li> <li>Biomass boilers</li> <li>Biomass community<br/>heating scheme</li> </ul> | Ν   | <ul> <li>Additional deliveries and<br/>storage Issues</li> <li>Higher running costs</li> <li>No established supply chain in<br/>the area</li> <li>Management of Bi-products</li> </ul>  |  |  |  |  |  |  |  |  |
| <ul> <li>Biomass CHP</li> <li>Natural gas CHP</li> <li>Sewerage gas and other biogases CHP</li> </ul>                             | N   | <ul> <li>Conflicts with gas CHP</li> <li>Additional deliveries and<br/>storage issues</li> <li>Higher running costs</li> <li>No established supply chain in<br/>the area</li> </ul>   |  |  |  |  |  |  |  |  |
| Ground source heat     pumps  | N   | <ul> <li>No open land for horizontal<br/>piping</li> </ul>  |  |  |  |  |  |  |  |  |
| Water source heat   | Ν   | Unknown ground conditions   |  |  |  |  |  |  |  |  |
| pumps   | Ν   | <ul> <li>No water source in close</li> </ul>  |  |  |  |  |  |  |  |  |
| <ul> <li>Air source heat<br/>pumps</li> </ul>   |     | proximity to the site plus<br>license restrictions and  |  |  |  |  |  |  |  |  |
|   | Y   | <ul> <li>associated risks</li> <li>Highly efficient ASHP has<br/>been considered to provide<br/>heating &amp; Domestic hot water<br/>to the whole building, while<br/>comfort cooling only to<br/>commercial spaces.</li> </ul> |  |  |  |  |  |  |  |  |
| Fuel cells using  | N   | <ul> <li>No source of hydrogen</li> </ul>   |  |  |  |  |  |  |  |  |
| hydrogen generated  |     | <ul> <li>The required size is not</li> </ul>  |  |  |  |  |  |  |  |  |
| from any of the above   |     | commercially available  |  |  |  |  |  |  |  |  |
| 'renewable' sources   |     | <ul> <li>Higher capital costs compare<br/>to CHP</li> </ul>   |  |  |  |  |  |  |  |  |

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An initial assessment has been carried out to determine which technologies are technically, functionally and economically feasible on the site. All technologies appropriate to the site and energy demand of the development have been assessed. Where technologies are not considered appropriate, these have been highlighted in the Table above.

#### 5.1 Low Temperature Hot Water Community Heating System

The community heating system consist of a LTHP Air Source Heat Pump ASHP located in a central plant room, supplying individual ASHPs in individual dwellings to supply the space and DHW requirements. Low temperature hot water systems reduce energy and save money as well as the environment, through reduced carbon emissions. They produce hot water for space heating and DHW at 25 degrees Celsius.

They are used primarily for heating or producing hot water. New ASHPs replace old hot water boilers can achieve efficiencies of over 350%.

This novel configuration significantly decreases the circulation heat losses attributed to conventional hydronic communal heating systems, which typically, have a requirement of a continuous loop of high temperature water supply. This system also beneficially alters the proportion of the DHW and space heating requirements. This technology if further improved with the falling primary Energy Factor (PEF) which connects primary and final energy, indicating how much primary energy is used to generate a unit of electricity, 2.8 for electricity.

Low temperate water flows around the building's main loop at 15-25 degrees to each apartment. The energy input to this loop is from an onsite heat pump. Each apartment has it's own mini loop where an individual heap pump produces heated water to the required temperature. The water will then also be supplied to radiators and, if required for the retail units, be passed to fan coils. As this water in the heat network is at ambient temperatures loses can be as low as 2%.

This results in more comfortable temperatures within apartments and reduced overheating in communal areas - both common challenges that face conventional heating systems within modern apartment blocks. Additionally, the cost of heating system losses is no longer spread across all residents, meaning they only pay for the heating they use.



The community heating system has a number of benefits in addition to the energy saving potential of low temperature heat networks.

- The improved comfort experienced by occupants particularly in the summertime avoiding apartment over-heating risk, reduced corridor temperatures.
- provision of heating hot water via a 2-pipe system with no requirement for refrigerant pipe work or leak detection as everything is water based.
- Cooling will only be provided to commercial units
- Significantly smaller Plant rooms and the potential for modular design.
- Implementation of the London Plan requirement for zero-carbon designs

#### 5.2 Viability of Solar Photovoltaic

In the London area there is an annual average solar energy availability of 1MWh/M<sup>2</sup> at the optimum (south facing) angle of 30° from the horizontal plane. The amount of this energy that can be utilised is dependent upon the availability of un-shaded roof space and efficiency of the solar panels considered whilst considering the value of other environmental measures such as biodiversity roofs or other measures to reduce the impact of the heat island.

The potential locations of solar panels have been investigated in conjunction with the Architect, Structural Engineer and Building Services Engineers, to identify any aesthetic, safety and structural implications. A roof mounted system has been considered, and the study has determined that the main roof area is the only suitable space for locating panels whilst optimising cost viability.

The roof in this location is likely to also accommodate some plant, but is accessible for maintenance, and is currently deemed 100% un-shaded by surrounding buildings over the year.

Good practice efficiency panels have been considered within this study (18.2% module efficiency). An indicative PV array delivering 8,084kWh/year is proposed to be located on the roof, leaving additional space for maintenance access and to prevent overshadowing. This relates to approximately 44no 230Wp panels. Appendix C illustrates the roof layout and anticipated location of the current PV proposal which considers orientation and other requirements/beneficial uses of roof space.

The panels are currently proposed to be mounted on a frame or preformed system at 0° and be south-west facing, an optimised orientation given the building orientation and the need for reduced height given sensitive views from surroundings.

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The PV is to be located away from the immediate vicinity of any locally roof mounted ventilation system, plant and raised roof light. Design details to be further investigated during detailed design.

The electrical output from the PV will be synchronized with the mains supply for the building and directly reduce the electricity demand from the national grid to the Landlord areas. It is not anticipated that the PV panels will produce more electricity than is continually used within the landlord areas however final details will be considered for export arrangements should the need arise during detail design.

The predicted energy generation and related  $CO_2$  savings of applying a solar PV system can be seen in the Table below:

| Technology         | Collector Area | Electricity<br>Generated | Energy saving | CO2 Savings            |
|--------------------|----------------|--------------------------|---------------|------------------------|
|                    | (m²)           | (kWh/yr)                 | (kWh/yr)      | (tCO <sub>2</sub> /yr) |
| 10kWp PV<br>System | 48             | 8,084                    | 8,084         | 4.08                   |

The estimated technical and commercial feasibility of a photovoltaic system for the proposed re-development is presented in the table below:

| Indicative Capital Cost (£)                | £ 18,000.00   |
|--|---|
| Indicative Maintenance Costs (£)           | £4000 (over the 20-year period)                           |
| · · · ·                                    | NB: Assumes 1no inverter                                  |
|  |   |
| Indicative Payback (years)                 | 8-12 years  |
| , , , , , , , , , , , , , , , , , , ,      | NB: Lifetime of panel = approx. 20 years                  |
|  |   |
| Land Use                                   | The panels are to be roof mounted and                     |
|  | space would be required for the inverter                  |
|  | within a plant room or cupboard                           |
| Local Planning Requirements                | Appropriately designed Photovoltaic arrays                |
| 5 1  | mounted on flat roofs are typically looked                |
|  | upon favorably by local planners and the                  |
|  | GLA.  |
| Noise                                      | None  |
| Life cycle cost / lifecycle impact of the  | PV systems typically result in life-cycle CO <sub>2</sub> |
| potential specification in terms of carbon | savings (typical embodied CO <sub>2</sub> payback is 3-   |
| emissions                                  | 6 years) Lifecycle cost savings are                       |
|  | dependent on FIT rates at the time of                     |
|  | installation  |
|  |   |
|  |   |



#### 6 Conclusions

The tables below demonstrate the predicted CO2 emissions for the anticipated total development.

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

|  | Carbon Dioxide Emissions for domestic buildings<br>(Tonnes CO2 per annum) |             |  |  |  |  |
|--|---|-------------|--|--|--|--|
|  | Regulated   | Unregulated |  |  |  |  |
| Baseline: Part L 2013 of the Building<br>Regulations Compliant Development | 8   | 10          |  |  |  |  |
| After energy demand reduction  | 6   | 9           |  |  |  |  |
| After heat network / CHP   | 6   | 9           |  |  |  |  |
| After renewable energy   | 1   | 9           |  |  |  |  |

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

|   | Regulated domestic c               | arbon dioxide savings |  |  |
|---|------------------------------------|-----------------------|--|--|
|   | (Tonnes CO <sub>2</sub> per annum) | (%)                   |  |  |
| Savings from energy demand reduction      | 2                                  | 23%                   |  |  |
| Savings from heat network / CHP           | 0                                  | 0%                    |  |  |
| Savings from renewable energy             | 5                                  | 60%                   |  |  |
| Cumulative on site savings                | 6                                  | 83%                   |  |  |
| Annual savings from off-set payment       | 1                                  | -                     |  |  |
|   | (Tonne                             | es CO2)               |  |  |
| Cumulative savings for off-set<br>payment | 39                                 | -                     |  |  |
| Cash in-lieu contribution (£)             | 2,348                              |                       |  |  |

The total predicted regulated CO2 savings achieved by the energy strategy is up to 6 tonnes CO2 per annum when compared against the Part L 2013 baseline scenario.

The table above shows the breakdown in predicted savings for each stage of the energy hierarchy. At this stage of the design the current predicted savings equate up to 83% reduction in regulated scheme  $CO_2$  emissions over the Part L 2016 baseline building emissions, achieving the London Plan target for carbon reduction. The cumulative savings for the offset payment over 30years is 39 Tonne CO2, which at £60/Tonne equate to £2,348. With the



revised cost of **£95/Tonne** being introduced in the 2020 London Plan the Cash in lieu contribution of **£3,705** for the development.

#### Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

|  | Carbon Dioxide Emissions<br>(Tonnes CO2 | -           |
|--|---|-------------|
|  | Regulated                               | Unregulated |
| Baseline: Part L 2013 of the Building<br>Regulations Compliant Development | 14                                      | 71          |
| After energy demand reduction  | 5                                       | 71          |
| After heat network / CHP   | 5                                       | 71          |
| After renewable energy   | 3                                       | 71          |

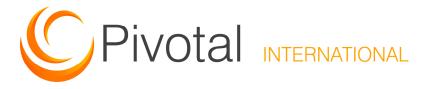
#### Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

|                                      | Regulated non-domesti              | c carbon dioxide savings |
|--------------------------------------|------------------------------------|--------------------------|
|                                      | (Tonnes CO <sub>2</sub> per annum) | (%)                      |
| Savings from energy demand reduction | 8                                  | 61%                      |
| Savings from heat network / CHP      | 0                                  | 0%                       |
| Savings from renewable energy        | 3                                  | 20%                      |
| Total Cumulative Savings             | 11                                 | 81%                      |

#### Table 5: Shortfall in regulated carbon dioxide savings

|                               | Annual Shortfall<br>(Tonnes CO <sub>2</sub> ) | Cumulative Shortfall<br>(Tonnes CO <sub>2</sub> ) |
|-------------------------------|---|---|
| Total Target Savings          | 5   | -   |
| Shortfall                     | -6  | -190  |
| Cash in-lieu contribution (£) | -11,427                                       | -   |

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#### 7 Site Wide Savings

|                      | Total regulated emissions<br>(Tonnes CO2 / year) | CO2 savings<br>(Tonnes CO2 / year)  | Percentage savings<br>(%) |
|----------------------|--|-------------------------------------|---------------------------|
| Part L 2013 baseline | 21   |                                     |                           |
| Be lean              | 11   | 10                                  | 48%                       |
| Be clean             | 11   | 0                                   | 0%                        |
| Be green             | 4  | 7                                   | 34%                       |
|                      | -  | CO2 savings off-set<br>(Tonnes CO2) | -                         |
| Off-set              | -  | -153                                | -                         |

#### 8 Appendix

#### 8.1 Off-Site Construction

Offsite Construction: is a fundamental change to the design philosophy approach. It requires designing buildings layout to combine multiple products and disciplines such building envelope, mechanical & Electrical services in one package which can be, as far as is feasible, fabricated, assembled and tested off site and delivered as a plug and play product. This principal is applied to prefabricated modular construction. The Off-Site Construction (OSC) principle is more commonly being adopted with investment in the design aspect of projects which integrate off-site manufacturing and assembly from both financial and staff upskilling perspectives.

Offsite Construction delivers of Low-carbon prefabricated modular construction and fabrication systems. Using prefabricated engineered systems for buildings and ancillary services. Offsite Construction can reduce the embodied energy by up to 30%.

The Key benefits are:

Design with disassembly in mind will enhance the reuse of materials. This will effectively increase their life-span and the energy efficiency of the plants in which they are used and will offer significant opportunities for embodied energy reductions.

Cradle to Cradle: Also known as regenerative design. This is a biomimetic approach to the design of products and systems that industry on nature's processes viewing materials as nutrients circulating in healthy, safe metabolisms. The reuse of materials is focused on during



the design of products, Manufacturers no longer sell their goods, but rather they provide them and then take them back in order to reuse them.

It takes into consideration both economic as well as environmental and social aspects when choosing materials and building materials. It allows for a wide range of perspectives on the creation and use of products.

Efficiency and predictability: By building offsite, delivery of project Work Packages can be guaranteed to be on time and to the highest quality, as mitigating circumstances such as bad weather do not delay the project and the majority of testing and certification can be carried out in a controlled environment.

Quality assurance: The quality of finished product is improved as the construction is undertaken in a controlled factory environment which allows for a higher quality finish and inspection methodology to be far more extensive. Reduced defects and snagging (up to 80%) will have a significant positive impact on the delivery of the project within the scheduled timeframe.

Sustainability: Offsite construction requires less heavy machinery and less energy. Transporting the finished product to the site also uses minimal vehicles, and wastage is minimized, as material requirements can be more accurately calculated, allowing the company to make savings by buying in bulk. Material can also be recycled in a more efficient manner. A company policy to ensure all waste conforms to the principals of reuse and recycle which can reduce waste by up to 20% and divert up to 85% of the waste streams from landfill.

Health & Safety: The factory is a far more predictable setting than the physical construction site, which eliminates the variables of weather and visibility. Factory conditions' replicability makes errors much less likely. Most of onsite construction's most dangerous hazards: like fall from height and equipment accidents, are not an issue in the factory. A policy of pre-slung deliveries to site reduces risk through ensuring there is not requirement for operators onsite to prepare loads for lifting. This can lead to up to 80% improvement in on-site Health & Safety outcomes.

Reduced labour: Factory located fabrication and construction requires less labour for comparable site-based projects. Also, reductions of up to 75 % on-site labour can be achieved.

Reduced training: teaching workers to perform their role in an offsite build is much simpler and faster. Transferring the construction process to a factory setting essentially turns building, mechanical and electrical works into a manufacturing process. Less training means faster delivery.



Less local disruption and positive effect on local communities and environment: Reduced onsite works will reduces disruption to residents from the noise and air pollution of heavy machinery and equipment. Additionally, construction and delivery vehicles travelling to and from the site can cause traffic delays blocking parking spaces and access routes. This can be a particular problem in constrained areas of SAC and tourism. The potential effects civil works can have can be mitigated by offsite construction allaying fears of local residents as construction works and cranes can be an eyesore therefore the reduction of plant time onsite can be beneficial to all stakeholders. Up to 80% improvement can be achieved.

Project scheduling: OSC allows removal of aspects of the mechanical and electrical installation from the critical path of the construction programme. To achieve this a number of key processes will take place:

- Early engagement with site installation crews at design phase for prior lessons learned session
- Digital rehearsal of installation using latest 4D scheduling software
- Installation sequence collaboration session with project and site install team before first deliveries
- Innovative designs adopted and implemented
- Post project competition lessons learned reviews

Pivotal are now using historic data from previous projects to develop a model to assess the carbon footprint of the Off-Site Construction component of sections or whole projects both new developments and retrofitting.

All other waste material generated during construction will be contained, transported, and managed in accordance with all Waste Management legislation. All the contractors used should adhere to the reuse & recycle principals outlined. All works designed and constructed will be conscious of the determination for energy use reduction, carbon footprint reduction, energy efficiency, energy recovery and installation of renewable energy systems, where deemed feasible.



#### 8.2 BRUKL & SAP Reports

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#### 8.3 PV Array layout

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|   |  | U                           | ser Details:                     |                    |                  |                      |              |                                 |                     |
|---|--|-----------------------------|----------------------------------|--------------------|------------------|----------------------|--------------|---------------------------------|---------------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 2012   |                             | Softwa                           | a Numb<br>are Vers |                  |                      | Versio       | n: 1.0.4.23                     |                     |
| A daha a a  | 1 Red Elet 210 222   |                             | erty Address:                    |                    | h lunat          | ion ION              |              |                                 |                     |
| Address :<br>1. Overall dwelling dimen  | 1 Bed Flat, 219-223 (  | Colonarbo                   | ur Lane, Louç                    | nboroug            | n Junci          | ION, LOP             | NDON         |                                 |                     |
| Ground floor  |  | [                           | Area(m²)<br>51.7                 | (1a) x             | Av. Hei<br>2     | i <b>ght(m)</b><br>5 | (2a) =       | Volume(m <sup>3</sup><br>129.25 | <b>')</b><br>(3a)   |
| Total floor area TFA = (1a)   | )+(1b)+(1c)+(1d)+(1e)  | +(1n)                       | 51.7                             | (4)                |                  |                      |              |                                 |                     |
| Dwelling volume   |  | _                           |                                  | (3a)+(3b)-         | +(3c)+(3d        | )+(3e)+              | .(3n) =      | 129.25                          | (5)                 |
| 2. Ventilation rate:  |  |                             |                                  |                    |                  |                      |              |                                 |                     |
| Number of chimneys<br>Number of open flues  |  | 0                           | • 0<br>• 0                       | ] = [              | <b>total</b> 0 0 |                      | 40 =<br>20 = | 0<br>0                          | (6a)<br>(6b)        |
| Number of intermittent fan  | s  | -                           | _                                |                    | 2                | x 1                  | 0 =          | 20                              | `<br>(7a)           |
| Number of passive vents   |  |                             |                                  |                    |                  |                      | 0 =          | -                               |                     |
| -   |  |                             |                                  |                    | 0                |                      | 10 =         | 0                               | (7b)                |
| Number of flueless gas fire   |  | )+(6b)+(7a)+                | (7b)+(7c) =                      |                    | 0                |                      |              | 0<br>anges per ho               | (7c)<br>our<br>(8)  |
| If a pressurisation test has be<br>Number of storeys in the<br>Additional infiltration<br>Structural infiltration: 0.2<br>if both types of wall are pre | en carried out or is intended<br>e dwelling (ns)<br>25 for steel or timber fr<br>sent, use the value corresp | d, proceed to<br>ame or 0.3 | (17), otherwise of 35 for masonr | y constru          | om (9) to (      | 16)                  | ·1]x0.1 =    | 0 0 0                           | (9)<br>(10)<br>(11) |
| deducting areas of opening<br>If suspended wooden flo   |  | ed) or 0.1 (                | sealed), else                    | enter 0            |                  |                      | [            | 0                               | (12)                |
| If no draught lobby, ente   |  | , (                         | ,,                               |                    |                  |                      |              | 0                               | (13)                |
| Percentage of windows   | and doors draught str  | ipped                       |                                  |                    |                  |                      |              | 0                               | (14)                |
| Window infiltration   |  |                             | 0.25 - [0.2                      | x (14) ÷ 10        | = [00            |                      |              | 0                               | (15)                |
| Infiltration rate   |  |                             | (8) + (10)                       | + (11) + (12       | 2) + (13) +      | + (15) =             |              | 0                               | (16)                |
| Air permeability value, q   | •  | •                           | •                                | •                  | etre of e        | nvelope              | area         | 5                               | (17)                |
| If based on air permeability<br>Air permeability value applies  |  |                             |                                  |                    | o hoing ur       | ad                   |              | 0.4                             | (18)                |
| Number of sides sheltered   |  | been done of                | r a degree all pe                | meaning R          | s being us       | eu                   | ſ            | 2                               | (19)                |
| Shelter factor  |  |                             | (20) = 1 -                       | 0.075 x (19        | 9)] =            |                      |              | 0.85                            | (20)                |
| Infiltration rate incorporatir  | ng shelter factor  |                             | (21) = (18)                      | x (20) =           |                  |                      |              | 0.34                            | (21)                |
| Infiltration rate modified for  | r monthly wind speed   |                             |                                  |                    |                  |                      | •            |                                 |                     |
| Jan Feb M   | /lar Apr May   | Jun                         | Jul Aug                          | Sep                | Oct              | Nov                  | Dec          |                                 |                     |
| Monthly average wind spe  | ed from Table 7  |                             |                                  |                    |                  |                      |              |                                 |                     |
| (22)m= 5.1 5 4  | .9 4.4 4.3   | 3.8                         | 3.8 3.7                          | 4                  | 4.3              | 4.5                  | 4.7          |                                 |                     |
| Wind Factor (22a)m = (22)   | im ÷ 4   |                             |                                  |                    |                  |                      |              |                                 |                     |
| (22a)m= 1.27 1.25 1.  | 23 1.1 1.08  | 0.95 0                      | 0.95 0.92                        | 1                  | 1.08             | 1.12                 | 1.18         |                                 |                     |

| Adjuste      | ed infiltra            | ation rat                       | e (allow          | ing for sh                    | elter an          | d wind s       | peed) =           | (21a) x        | (22a)m                    |                |             |                |          |                |
|--------------|------------------------|---------------------------------|-------------------|-------------------------------|-------------------|----------------|-------------------|----------------|---------------------------|----------------|-------------|----------------|----------|----------------|
|              | 0.44                   | 0.43                            | 0.42              | 0.38                          | 0.37              | 0.33           | 0.33              | 0.32           | 0.34                      | 0.37           | 0.39        | 0.4            |          |                |
|              |                        | c <i>tive air</i><br>al ventila | -                 | rate for ti                   | he appli          | cable ca       | se                |                |                           |                |             |                | 0        | (23a)          |
|              |                        |                                 |                   | endix N, (2                   | 3b) = (23a        | ) × Fmv (e     | equation (        | N5)) , othe    | rwise (23b                | ) = (23a)      |             |                | 0        | (23b)          |
|              |                        |                                 |                   | iency in %                    |                   |                |                   |                |                           | , , ,          |             |                | 0        | (200)<br>(23c) |
|              |                        |                                 | -                 | -                             | -                 |                |                   |                |                           | 2b)m + (       | 23b) x [    | l<br>1 – (23c) | -        | (200)          |
| (24a)m=      |                        | 0                               | 0                 | 0                             | 0                 | 0              | 0                 | 0              | 0                         | 0              | 0           | 0              |          | (24a)          |
| b) If        | balance                | d mecha                         | anical ve         | entilation                    | without           | heat rec       | covery (N         | и<br>ЛV) (24b  | m = (22)                  | 1<br>2b)m + (1 | 23b)        |                |          |                |
| ,<br>(24b)m= |                        | 0                               | 0                 | 0                             | 0                 | 0              | 0                 | 0              | 0                         | 0              | 0           | 0              |          | (24b)          |
| c) If        | whole h                | ouse ex                         | tract ver         | ntilation c                   | or positiv        | e input v      | ventilatio        | n from o       | outside                   |                |             |                |          |                |
| i            | f (22b)n               | n < 0.5 ×                       | (23b),            | then (24c                     | c) = (23b         | ); otherv      | wise (24          | c) = (22k      | o) m + 0.                 | .5 × (23b      | <b>)</b> )  | -              |          |                |
| (24c)m=      | 0                      | 0                               | 0                 | 0                             | 0                 | 0              | 0                 | 0              | 0                         | 0              | 0           | 0              |          | (24c)          |
|              |                        |                                 |                   | ole hous                      |                   |                |                   |                |                           | 0 =1           |             |                |          |                |
|              | , ,                    |                                 | <u>`</u>          | m = (22k)                     | ,                 | ,              | , <u> </u>        | <u> </u>       | , <u> </u>                | <u> </u>       | 0.57        | 0.50           |          | (244)          |
| (24d)m=      |                        | 0.59                            | 0.59              | 0.57                          | 0.57              | 0.55           | 0.55              | 0.55           | 0.56                      | 0.57           | 0.57        | 0.58           |          | (24d)          |
| (25)m=       | 0.6                    | change<br>0.59                  | rate - ei<br>0.59 | nter (24a                     | ) or (24b<br>0.57 | o) or (24)     | c) or (24<br>0.55 | d) in box      | x (25)                    | 0.57           | 0.57        | 0.58           | l        | (25)           |
| (25)11=      | 0.8                    | 0.59                            | 0.59              | 0.57                          | 0.57              | 0.55           | 0.55              | -0.55          | 0.56                      | 0.57           | 0.57        | 0.58           |          | (23)           |
| 3. Hea       | at l <mark>osse</mark> | s and he                        | eat loss          | paramete                      | er:               |                |                   |                |                           |                |             |                |          |                |
| ELEN         |                        | Gros<br>area                    |                   | Openin<br>m                   |                   | Net Ar<br>A ,r |                   | U-valı<br>W/m2 |                           | A X U<br>(W/   | K)          | k-value        |          | ∖Xk<br>J/K     |
| Window       | ws Type                |                                 | (111-)            |                               |                   | , r<br>9       |                   | /[1/( 1.4 )+   |                           | 11.93          |             | KJ/111-•1      |          | (27)           |
|              | ws Type                |                                 |                   |                               |                   | 3.92           |                   | /[1/( 1.4 )+   | L L                       | 5.2            | H           |                |          | (27)           |
| Floor        | ws rype                | . 2                             |                   |                               |                   |                |                   | r              |                           |                | H,          |                |          | (27)           |
| Walls 1      |                        | 40-                             | -                 |                               | \                 | 51.7           |                   | 0.13           |                           | 6.721          | ╘┤┟         |                | ╡┝━      |                |
| Walls 1      |                        | 19.7                            |                   | 9                             |                   | 10.75          |                   | 0.18           |                           | 1.94           |             |                | $\dashv$ | (29)           |
| Walls 7      |                        | 14.7                            |                   | 3.92                          |                   | 10.83          |                   | 0.18           |                           | 1.95           |             |                | $\dashv$ | (29)           |
|              |                        | 20                              |                   | 0                             |                   | 20             | ×                 | 0.18           | =                         | 3.6            |             |                |          | (29)           |
|              |                        | lements                         | , 111-            |                               |                   | 106.2          |                   |                |                           |                | — , r       |                |          | (31)           |
| Party v      |                        |                                 |                   |                               |                   | 20             | ×                 | 0              | =                         | 0              |             |                | ╡ ┝━     | (32)           |
| Party c      | -                      |                                 |                   |                               |                   | 51.7           |                   |                |                           |                | l           |                | _        | (32b)          |
|              | I wall **              |                                 |                   | <i></i>                       |                   | 77             |                   |                | <i>TE ( 4 / 1 - 1 - 1</i> | 1.0.047        | . [         |                |          | (32c)          |
|              |                        |                                 |                   | effective wil<br>nternal wall |                   |                | ated using        | formula 1      | /[(1/U-valu               | ie)+0.04] a    | as given in | paragraph      | 1 3.2    |                |
| Fabric       | heat los               | s, W/K :                        | = S (A x          | U)                            |                   |                |                   | (26)(30)       | ) + (32) =                |                |             |                | 31.33    | (33)           |
| Heat ca      | apacity                | Cm = S(                         | (Axk)             |                               |                   |                |                   |                | ((28)                     | (30) + (32     | 2) + (32a). | (32e) =        | 11416.3  | (34)           |
| Therma       | al mass                | parame                          | ter (TM           | ⊃ = Cm ÷                      | TFA) in           | ı kJ/m²K       |                   |                | Indica                    | tive Value     | : Medium    |                | 250      | (35)           |
|              | •                      | sments wh<br>ad of a de         |                   | etails of the<br>ulation.     | constructi        | ion are not    | t known pr        | ecisely the    | e indicative              | e values of    | TMP in T    | able 1f        |          |                |
| Therma       | al bridge              | es : S (L                       | x Y) cal          | culated u                     | using Ap          | pendix ł       | <                 |                |                           |                |             |                | 5.31     | (36)           |
| if details   | of therma              | al bridging                     | are not kr        | nown (36) =                   | = 0.05 x (3       | 1)             |                   |                |                           |                |             |                |          |                |
|              | abric he               |                                 |                   |                               |                   |                |                   |                | (33) +                    | (36) =         |             |                | 36.64    | (37)           |
| Ventila      | tion hea               |                                 | i                 | d monthly                     |                   |                |                   | 1              | · · ·                     | = 0.33 × (     | 25)m x (5   |                | I        |                |
|              | Jan                    | Feb                             | Mar               | Apr                           | May               | Jun            | Jul               | Aug            | Sep                       | Oct            | Nov         | Dec            |          |                |

| (38)m=           | 25.43                | 25.27        | 25.11            | 24.38                     | 24.24          | 23.6        | 23.6            | 23.49               | 23.85       | 24.24                    | 24.52                                 | 24.81      |         | (38)     |
|------------------|----------------------|--------------|------------------|---------------------------|----------------|-------------|-----------------|---------------------|-------------|--------------------------|---------------------------------------|------------|---------|----------|
| Heat tr          | ansfer o             | coefficie    | nt, W/K          |                           |                |             |                 |                     | (39)m       | = (37) + (3              | 38)m                                  |            |         |          |
| (39)m=           | 62.07                | 61.91        | 61.76            | 61.02                     | 60.89          | 60.25       | 60.25           | 60.13               | 60.49       | 60.89                    | 61.16                                 | 61.46      |         |          |
| Heat lo          | ss para              | ımeter (H    | HLP), W          | /m²K                      |                |             |                 |                     |             | Average =<br>= (39)m ÷   | Sum(39) <sub>1</sub><br>· (4)         | 12 /12=    | 61.02   | (39)     |
| (40)m=           | 1.2                  | 1.2          | 1.19             | 1.18                      | 1.18           | 1.17        | 1.17            | 1.16                | 1.17        | 1.18                     | 1.18                                  | 1.19       |         |          |
| Numbe            | or of day            | vs in mo     | nth (Tab         | le 12)                    |                |             |                 |                     |             | Average =                | Sum(40)1                              | 12 /12=    | 1.18    | (40)     |
|                  | Jan                  | Feb          | Mar              | Apr                       | May            | Jun         | Jul             | Aug                 | Sep         | Oct                      | Nov                                   | Dec        |         |          |
| (41)m=           | 31                   | 28           | 31               | 30                        | 31             | 30          | 31              | 31                  | 30          | 31                       | 30                                    | 31         |         | (41)     |
| I                |                      | 1            | 1                |                           |                |             |                 | 1                   |             |                          |                                       |            |         |          |
| 4. Wa            | ter heat             | ting ene     | rgy requ         | irement:                  |                |             |                 |                     |             |                          |                                       | kWh/yea    | ar:     |          |
| if TF.<br>if TF. | A > 13.9<br>A £ 13.9 | 9, N = 1     | + 1.76 x         | [1 - exp                  |                |             |                 |                     |             | TFA -13.                 |                                       | 74         |         | (42)     |
|                  |                      |              |                  | ge in litre<br>usage by s |                |             |                 |                     |             | se target o              |                                       | 5.53       |         | (43)     |
| not more         | that 125             | litres per   | person pe        | r day (all w              | ater use, l    | hot and co  | ld)             |                     |             |                          |                                       |            |         |          |
|                  | Jan                  | Feb          | Mar              | Apr                       | Мау            | Jun         | Jul             | Aug                 | Sep         | Oct                      | Nov                                   | Dec        |         |          |
| Hot wate         | er usage i           | n litres pei | r day for ea     | ach month                 | Vd,m = fa      | ctor from T | Table 1c x      | (43)                |             |                          |                                       |            |         |          |
| (44)m=           | 83.08                | 80.06        | 77.04            | 74.02                     | 71             | 67.98       | 67.98           | 71                  | 74.02       | 77.04                    | 80.06                                 | 83.08      | _       | <b>-</b> |
| Energy o         | content of           | hot water    | used - ca        | culated mo                | onthly $= 4$ . | 190 x Vd,r  | n x nm x D      | )<br>)<br>Tm / 3600 |             |                          | m(44) <sub>112</sub> =<br>ables 1b, 1 |            | 906.36  | (44)     |
| (45)m=           | 123.21               | 107.76       | 111.2            | 96. <mark>9</mark> 5      | 93.02          | 80.27       | 74.38           | 85.36               | 86.37       | 100.66                   | 109.88                                | 119.32     |         |          |
| lf instant       | anoous w             | vator boati  | na at noin       | t of use (no              | bot water      | r storage)  | enter 0 in      | boyes (16           |             | Tota <mark>l = Su</mark> | m(45) <sub>112</sub> =                | -          | 1188.38 | (45)     |
| (46)m=           | 18.48                | 16.16        | 16.68            | 14.54                     | 13.95          | 12.04       | 11.16           | 12.8                | 12.96       | 15.1                     | 16.48                                 | 17.9       |         | (46)     |
| · · ·            | storage              |              | 10.00            | 14.04                     | 13.95          | 12.04       | 11.10           | 12.0                | 12.90       | 15.1                     | 10.40                                 | 17.9       |         | (40)     |
| Storage          | e volum              | e (litres)   | ) includir       | ng any so                 | olar or W      | /WHRS       | storage         | within sa           | ame ves     | sel                      |                                       | 0          |         | (47)     |
|                  | •                    | •            |                  | nk in dw                  | •              |             |                 | · /                 |             | · · · (0) : · (          | 47)                                   |            |         |          |
|                  | ise if no<br>storage |              | not wate         | er (this in               | iciudes i      | nstantar    | ieous co        | iioa iamo           | ers) ente   | er 'U' in (              | 47)                                   |            |         |          |
|                  | •                    |              | eclared I        | oss facto                 | or is kno      | wn (kWł     | n/day):         |                     |             |                          | ,                                     | 0          |         | (48)     |
| Tempe            | rature f             | actor fro    | m Table          | 2b                        |                |             |                 |                     |             |                          |                                       | 0          |         | (49)     |
| Energy           | lost fro             | m watei      | · storage        | , kWh/ye                  | ear            |             |                 | (48) x (49)         | ) =         |                          |                                       | 0          |         | (50)     |
|                  |                      |              |                  | cylinder I<br>om Tabl     |                |             |                 |                     |             |                          |                                       |            |         | (54)     |
|                  |                      | -            | ee secti         |                           |                |             | iy)             |                     |             |                          |                                       | 0          |         | (51)     |
|                  |                      | from Ta      |                  |                           |                |             |                 |                     |             |                          |                                       | 0          |         | (52)     |
| Tempe            | rature f             | actor fro    | m Table          | 2b                        |                |             |                 |                     |             |                          |                                       | 0          |         | (53)     |
|                  |                      |              | -                | e, kWh/y€                 | ear            |             |                 | (47) x (51)         | x (52) x (  | 53) =                    |                                       | 0          |         | (54)     |
|                  | . ,                  | (54) in (5   |                  |                           |                |             |                 |                     |             |                          |                                       | 0          |         | (55)     |
|                  | storage              | loss cal     | culated          | for each                  | month          |             | i               | ((56)m = (          | 55) × (41)  | m                        |                                       |            |         |          |
| (56)m=           | 0                    | 0            | 0                | 0                         | 0              | 0           | 0               | 0                   | 0           | 0                        | 0                                     | 0          | . 11    | (56)     |
|                  | r contains           |              | a solar sto<br>1 | rage, (57)ı               | m = (56)m<br>I |             | H11)] ÷ (5<br>I | · ·                 | / )m = (56) | m where (                | H11) is fro<br>I                      | m Appendix | Η       |          |
| (57)m=           | 0                    | 0            | 0                | 0                         | 0              | 0           | 0               | 0                   | 0           | 0                        | 0                                     | 0          |         | (57)     |

|   | cuit loss (ar   |  |   |   | 50)  |   |   |   |  |  | 0   |               | (58)   |
|---|---|--|---|---|--|---|---|---|--|--|---|---------------|--|
|   | cuit loss ca<br>d by factor f   |  |   | •   | ,  | · ·   | ``'   |   | r thermo   | stat)  |   |               |  |
|   |   |  |   | 0   |  |   |   | 0   | 0  | 0  | 0   |               | (59)   |
| Combi los   | calculated  | for each   | month (   | (61)m =   | (60) ÷ 36  | 65 x (41)   |   |   |  |  |   |               |  |
| (61)m= 42   | 1   | 39.26  | 36.5  | 36.18   | 33.52  | 34.64   | 36.18   | 36.5  | 39.26  | 39.48  | 42.34                                       |               | (61)   |
| Total heat  | required for  | water h  | eating ca   | alculated   | l for eac  | h month   | (62)m =   | 0.85 x (  | (45)m +  | (46)m +  | (57)m +                                     | (59)m + (61)m |  |
|   | 5.55 144.61   | 150.46   | 133.45  | 129.2   | 113.79   | 109.02  | 121.54  | 122.88  | 139.92   | 149.36   | 161.66                                      | () (-)        | (62)   |
| Solar DHW ir  | put calculated  | using App  | endix G o   | r Appendix  | H (negati  | ve quantity   | /) (enter '0  | if no sola  | r contributi   | ion to wate  | er heating)                                 |               |  |
| (add additi   | onal lines if   | FGHRS  | and/or \  | NWHRS   | applies  | , see Ap  | pendix (  | G)  |  |  |   |               |  |
| (63)m=  | 0 0   | 0  | 0   | 0   | 0  | 0   | 0   | 0   | 0  | 0  | 0   |               | (63)   |
| Output from   | n water hea   | iter   | •   |   |  |   |   | -   |  | •  |   |               |  |
| (64)m= 165  | 5.55 144.61   | 150.46   | 133.45  | 129.2   | 113.79   | 109.02  | 121.54  | 122.88  | 139.92   | 149.36   | 161.66                                      |               |  |
|   |   |  |   |   |  |   | Outp  | out from wa   | ater heater  | r (annual)₁  | 12  | 1641.44       | (64)   |
| Heat gains  | from water  | heating,   | , kWh/m   | onth 0.2  | 5 ´ [0.85  | × (45)m   | ı + (61)m   | n] + 0.8 >  | (46)m  | + (57)m  | + (59)m                                     | ]             |  |
| (65)m= 51   | 55 45.04  | 46.79  | 41.36   | 39.97   | 35.07  | 33.39   | 37.43   | 37.85   | 43.28  | 46.41  | 50.26                                       |               | (65)   |
| include (   | 57)m in cal   | culation   | of (65)m  | only if c   | ylinder i  | s in the o  | dwelling  | or hot w  | ate <mark>r is f</mark> r  | om com   | munity h                                    | eating        |  |
| 5. Interna  | ai gains (see   | e Table {  | 5 and <b>5a</b>   | ):  |  |   |   |   |  |  |   |               |  |
| Metabolic   | gains (Table  | e 5), Wat  | tts   |   |  |   |   |   |  |  |   |               |  |
|   | an Feb  | Mar  | Apr   | May   | Jun  | Jul   | Aug   | Sep   | Oct  | Nov  | Dec   |               |  |
| (66)m= 87   | .01 87.01   | 87.01  | 87.01   | 87.01   | 87.01  | 87.01   | 87.01   | 87.01   | 87.01  | 87.01  | 87.01                                       |               | (66)   |
| Ligh <mark>ting g</mark> a  | ins (calcula  | ted in A   | opendix   | L. equat  | ion I 9 o  |   |   |   |  |  | -   |               |  |
| (67)m= 13   | .52 12.01   | F  |   | -, • • •  |  | r L9a), a   | lso see <sup>-</sup>  | Table 5   |  |  |   |               |  |
|   | 12.01   | 9.77   | 7.39  | 5.53  | 4.67   | r L9a), a<br>5.04   | lso see<br>6.55   | Table 5<br>8.8  | 11.17  | 13.03  | 13.9  |               | (67)   |
| Appliances  | gains (calc   | 1  |   | 5.53  | 4.67   | 5.04  | 6.55  | 8.8   |  | 13.03  | 13.9  |               | (67)   |
| · · ·   |   | 1  |   | 5.53  | 4.67   | 5.04  | 6.55  | 8.8   |  | 13.03<br>134.94                                      | 13.9<br>144.96                              |               | (67)<br>(68)   |
| (68)m= 151  | gains (calc   | ulated ir<br>149.26  | Append<br>140.81  | 5.53<br>dix L, eq<br>130.16   | 4.67<br>uation L<br>120.14   | 5.04<br>13 or L1<br>113.45  | 6.55<br>3a), alsc<br>111.88   | 8.8<br>see Ta<br>115.84   | ble 5<br>124.28  |  |   |               |  |
| (68)m= 15<br>Cooking g  | gains (calc<br>.65 153.22<br>ains (calcula  | ulated ir<br>149.26  | Append<br>140.81<br>ppendix   | 5.53<br>dix L, eq<br>130.16<br>L, equat   | 4.67<br>uation L<br>120.14<br>tion L15   | 5.04<br>13 or L1<br>113.45<br>or L15a)  | 6.55<br>3a), alsc<br>111.88<br>), also se   | 8.8<br>see Ta<br>115.84   | ble 5<br>124.28  |  |   |               |  |
| (68)m= 15<br>Cooking ga<br>(69)m= 31  | gains (calc<br>.65 153.22<br>ains (calcula  | tulated in<br>149.26<br>ated in A<br>31.7  | Append<br>140.81<br>ppendix<br>31.7   | 5.53<br>dix L, eq<br>130.16<br>L, equat   | 4.67<br>uation L<br>120.14<br>tion L15   | 5.04<br>13 or L1<br>113.45<br>or L15a)  | 6.55<br>3a), alsc<br>111.88<br>), also se   | 8.8<br>o see Ta<br>115.84<br>ee Table                                 | ble 5<br>124.28<br>5   | 134.94   | 144.96                                      |               | (68)   |
| (68)m= 15 <sup>4</sup><br>Cooking ga<br>(69)m= 31<br>Pumps and  | a gains (calc<br>.65 153.22<br>ains (calcula<br>.7 31.7   | tulated in<br>149.26<br>ated in A<br>31.7  | Append<br>140.81<br>ppendix<br>31.7   | 5.53<br>dix L, eq<br>130.16<br>L, equat   | 4.67<br>uation L<br>120.14<br>tion L15   | 5.04<br>13 or L1<br>113.45<br>or L15a)  | 6.55<br>3a), alsc<br>111.88<br>), also se   | 8.8<br>o see Ta<br>115.84<br>ee Table                                 | ble 5<br>124.28<br>5   | 134.94   | 144.96                                      |               | (68)   |
| (68)m= 15<br>Cooking ga<br>(69)m= 31<br>Pumps and<br>(70)m= 3   | a gains (calc<br>.65 153.22<br>ains (calcula<br>.7 31.7<br>d fans gains   | ated in A<br>31.7<br>(Table \$   | Appendix<br>140.81<br>ppendix<br>31.7<br>5a)<br>3                                 | 5.53<br>dix L, eq<br>130.16<br>L, equat<br>31.7<br>3                                | 4.67<br>uation L<br>120.14<br>ion L15<br>31.7<br>3                                       | 5.04<br>13 or L1<br>113.45<br>or L15a)<br>31.7                                      | 6.55<br>3a), also<br>111.88<br>), also se<br>31.7                                       | 8.8<br>5 see Ta<br>115.84<br>5e Table<br>31.7                         | ble 5<br>124.28<br>5<br>31.7                                       | 134.94<br>31.7                                       | 144.96<br>31.7                              |               | (68)<br>(69)   |
| (68)m= 15 Cooking ga<br>(69)m= 31<br>Pumps and<br>(70)m= 5<br>Losses e.g  | a gains (calc<br>.65 153.22<br>ains (calcula<br>.7 31.7<br>d fans gains<br>3 3  | ated in A<br>31.7<br>(Table \$   | Appendix<br>140.81<br>ppendix<br>31.7<br>5a)<br>3                                 | 5.53<br>dix L, eq<br>130.16<br>L, equat<br>31.7<br>3                                | 4.67<br>uation L<br>120.14<br>ion L15<br>31.7<br>3                                       | 5.04<br>13 or L1<br>113.45<br>or L15a)<br>31.7                                      | 6.55<br>3a), also<br>111.88<br>), also se<br>31.7                                       | 8.8<br>5 see Ta<br>115.84<br>5e Table<br>31.7                         | ble 5<br>124.28<br>5<br>31.7                                       | 134.94<br>31.7                                       | 144.96<br>31.7                              |               | (68)<br>(69)   |
| $(68)m = 15^{\circ}$<br>Cooking ga<br>$(69)m = 31^{\circ}$<br>Pumps and<br>$(70)m = 5^{\circ}$<br>Losses e.g<br>$(71)m = -65^{\circ}$ | a gains (calc<br>.65 153.22<br>ains (calcula<br>.7 31.7<br>d fans gains<br>3 3<br>. evaporatio  | culated in<br>149.26<br>ated in A<br>31.7<br>(Table 5<br>3<br>on (nega<br>-69.61                   | Appendix<br>140.81<br>ppendix<br>31.7<br>5a)<br>3<br>tive valu                    | 5.53<br>dix L, eq<br>130.16<br>L, equat<br>31.7<br>3<br>es) (Tab                    | 4.67<br>uation L<br>120.14<br>iion L15<br>31.7<br>3<br>le 5)                             | 5.04<br>13 or L1<br>113.45<br>or L15a)<br>31.7<br>3                                 | 6.55<br>3a), also<br>111.88<br>), also se<br>31.7<br>3                                  | 8.8<br>5 see Ta<br>115.84<br>ee Table<br>31.7<br>3                    | ble 5<br>124.28<br>5<br>31.7<br>3                                  | 134.94<br>31.7<br>3                                  | 144.96<br>31.7<br>3                         |               | (68)<br>(69)<br>(70)   |
| (68)m = 15 $Cooking ga$ $(69)m = 31$ $Pumps and$ $(70)m = 5$ $Losses e.c$ $(71)m = -65$ $Water hea$                                   | gains (calc         .65       153.22         ains (calcula         .7       31.7         d fans gains         3       3          evaporation         .61       -69.61   | culated in<br>149.26<br>ated in A<br>31.7<br>(Table 5<br>3<br>on (nega<br>-69.61                   | Appendix<br>140.81<br>ppendix<br>31.7<br>5a)<br>3<br>tive valu                    | 5.53<br>dix L, eq<br>130.16<br>L, equat<br>31.7<br>3<br>es) (Tab                    | 4.67<br>uation L<br>120.14<br>iion L15<br>31.7<br>3<br>le 5)                             | 5.04<br>13 or L1<br>113.45<br>or L15a)<br>31.7<br>3                                 | 6.55<br>3a), also<br>111.88<br>), also se<br>31.7<br>3                                  | 8.8<br>5 see Ta<br>115.84<br>ee Table<br>31.7<br>3                    | ble 5<br>124.28<br>5<br>31.7<br>3                                  | 134.94<br>31.7<br>3                                  | 144.96<br>31.7<br>3                         |               | (68)<br>(69)<br>(70)   |
| (68)m = 15<br>Cooking ga<br>(69)m = 31<br>Pumps and<br>(70)m = -65<br>Losses e.g<br>(71)m = -65<br>Water hea<br>(72)m = 69            | gains (calculation)         .65       153.22         ains (calculation)         .7       31.7         d fans gains         3       3         .9       evaporation         .61       -69.61         ting gains (7)   | culated in A<br>149.26<br>ated in A<br>31.7<br>(Table 5<br>on (nega<br>-69.61<br>Fable 5)<br>62.89 | Appendix<br>140.81<br>ppendix<br>31.7<br>5a)<br>3<br>tive valu<br>-69.61          | 5.53<br>dix L, eq<br>130.16<br>L, equat<br>31.7<br>3<br>es) (Tab<br>-69.61          | 4.67<br>uation L<br>120.14<br>iion L15<br>31.7<br>3<br>le 5)<br>-69.61<br>48.71          | 5.04<br>13 or L1<br>113.45<br>or L15a)<br>31.7<br>3<br>-69.61<br>44.88              | 6.55<br>3a), also<br>111.88<br>), also se<br>31.7<br>3<br>-69.61                        | 8.8<br>5 see Ta<br>115.84<br>ee Table<br>31.7<br>3<br>-69.61<br>52.56 | ble 5<br>124.28<br>5<br>31.7<br>3<br>-69.61<br>58.18               | 134.94<br>31.7<br>3<br>-69.61<br>64.45               | 144.96<br>31.7<br>3<br>-69.61<br>67.55      |               | (68)<br>(69)<br>(70)<br>(71)   |
| (68)m = 15 $Cooking ga$ $(69)m = 31$ $Pumps and$ $(70)m = 5$ $Losses e.c$ $(71)m = -65$ $Water hea$ $(72)m = 69$ $Total inter$        | gains (calcula         .65       153.22         ains (calcula         .7       31.7         d fans gains         3       3         .evaporation         .61       -69.61         ting gains (7         29       67.03                                     | culated in A<br>149.26<br>ated in A<br>31.7<br>(Table 5<br>on (nega<br>-69.61<br>Fable 5)<br>62.89 | Appendix<br>140.81<br>ppendix<br>31.7<br>5a)<br>3<br>tive valu<br>-69.61          | 5.53<br>dix L, eq<br>130.16<br>L, equat<br>31.7<br>3<br>es) (Tab<br>-69.61          | 4.67<br>uation L<br>120.14<br>iion L15<br>31.7<br>3<br>le 5)<br>-69.61<br>48.71          | 5.04<br>13 or L1<br>113.45<br>or L15a)<br>31.7<br>3<br>-69.61<br>44.88              | 6.55<br>3a), also<br>111.88<br>), also se<br>31.7<br>3<br>-69.61<br>50.3                | 8.8<br>5 see Ta<br>115.84<br>ee Table<br>31.7<br>3<br>-69.61<br>52.56 | ble 5<br>124.28<br>5<br>31.7<br>3<br>-69.61<br>58.18               | 134.94<br>31.7<br>3<br>-69.61<br>64.45               | 144.96<br>31.7<br>3<br>-69.61<br>67.55      |               | (68)<br>(69)<br>(70)<br>(71)   |
| (68)m = 15 $Cooking ga$ $(69)m = 31$ $Pumps and$ $(70)m = 5$ $Losses e.c$ $(71)m = -65$ $Water hea$ $(72)m = 69$ $Total inter$        | gains (calculation)         .65       153.22         ains (calculation)         .7       31.7         d fans gains         .3       3         .4       -69.61         ting gains (7         .29       67.03         rnal gains =         .56       284.36 | culated in A<br>149.26<br>ated in A<br>31.7<br>(Table 5<br>0n (nega<br>-69.61<br>Fable 5)<br>62.89 | Appendix<br>140.81<br>ppendix<br>31.7<br>5a)<br>3<br>tive valu<br>-69.61<br>57.44 | 5.53<br>dix L, eq<br>130.16<br>L, equat<br>31.7<br>3<br>es) (Tab<br>-69.61<br>53.73 | 4.67<br>uation L<br>120.14<br>iion L15<br>31.7<br>3<br>ile 5)<br>-69.61<br>48.71<br>(66) | 5.04<br>13 or L1<br>113.45<br>or L15a)<br>31.7<br>3<br>-69.61<br>44.88<br>m + (67)m | 6.55<br>3a), also<br>111.88<br>), also se<br>31.7<br>3<br>-69.61<br>50.3<br>0 + (68)m - | 8.8<br>5 see Ta<br>115.84<br>52.56<br>(69)m + (6)                     | ble 5<br>124.28<br>5<br>31.7<br>3<br>-69.61<br>58.18<br>(70)m + (7 | 134.94<br>31.7<br>3<br>-69.61<br>64.45<br>1)m + (72) | 144.96<br>31.7<br>3<br>-69.61<br>67.55<br>m |               | <ul> <li>(68)</li> <li>(69)</li> <li>(70)</li> <li>(71)</li> <li>(72)</li> </ul> |

| Orientation:   | Access Factor<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|----------------|---------------------------|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x | 0.77                      | x | 3.92       | x | 11.28            | x | 0.63           | x | 0.7            | = | 13.52        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.92       | x | 22.97            | × | 0.63           | × | 0.7            | = | 27.51        | (75) |

|  |                | -      |                            | _        | ·                          |                     |              |                     |                      |        |                      |              |
|--|----------------|--------|----------------------------|----------|----------------------------|---------------------|--------------|---------------------|----------------------|--------|----------------------|--------------|
| Northeast 0.9x                         | 0.77           | ×      | 3.92                       | ×        | 41.38                      |                     | 0.63         |                     | 0.7                  | =      | 49.57                | (75)         |
| Northeast 0.9x                         | 0.77           | ×      | 3.92                       | ×        | 67.96                      | x                   | 0.63         | ×                   | 0.7                  | =      | 81.41                | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | ×        | 91.35                      | x                   | 0.63         | ×                   | 0.7                  | =      | 109.43               | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | ×        | 97.38                      | x                   | 0.63         | ×                   | 0.7                  | =      | 116.67               | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | x        | 91.1                       | x                   | 0.63         | x                   | 0.7                  | =      | 109.14               | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | x        | 72.63                      | <b>x</b>            | 0.63         | ×                   | 0.7                  | =      | 87.01                | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | ×        | 50.42                      | <b>x</b>            | 0.63         | x                   | 0.7                  | =      | 60.4                 | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | x        | 28.07                      | <b>x</b>            | 0.63         | _ x [               | 0.7                  | =      | 33.62                | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | x        | 14.2                       | <b>x</b>            | 0.63         | x                   | 0.7                  | =      | 17.01                | (75)         |
| Northeast 0.9x                         | 0.77           | x      | 3.92                       | x        | 9.21                       | ) x [               | 0.63         | _ x [               | 0.7                  | =      | 11.04                | (75)         |
| Southwest <sub>0.9x</sub>              | 0.77           | x      | 9                          | x        | 36.79                      | ] [                 | 0.63         | ×                   | 0.7                  | =      | 101.2                | (79)         |
| Southwest <sub>0.9x</sub>              | 0.77           | x      | 9                          | x        | 62.67                      | ] [                 | 0.63         | ×                   | 0.7                  | =      | 172.38               | (79)         |
| Southwest <sub>0.9x</sub>              | 0.77           | x      | 9                          | ×        | 85.75                      | ĪĒ                  | 0.63         | ×                   | 0.7                  | =      | 235.86               | (79)         |
| Southwest <sub>0.9x</sub>              | 0.77           | x      | 9                          | x        | 106.25                     | ĪĒ                  | 0.63         | _ × [               | 0.7                  | =      | 292.25               | (79)         |
| Southwest <sub>0.9x</sub>              | 0.77           | ×      | 9                          | ×        | 119.01                     | ] [                 | 0.63         | _ × [               | 0.7                  | =      | 327.34               | (79)         |
| Southwest <sub>0.9x</sub>              | 0.77           | x      | 9                          | x        | 118.15                     | ĪĒ                  | 0.63         | _ × [               | 0.7                  | =      | 324.97               | (79)         |
| Southwest <sub>0.9x</sub>              | 0.77           | ×      | 9                          | x        | 113.91                     | ÌĒ                  | 0.63         | _ × [               | 0.7                  | =      | 313.31               | (79)         |
| Southwest0.9x                          | 0.77           | x      | 9                          | X        | 104.39                     |                     | 0.63         | x                   | 0.7                  | =      | 287.13               | (79)         |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77           | ×      | 9                          | x        | 92.85                      | ĪĒ                  | 0.63         | ×                   | 0.7                  | - 1    | 2 <mark>55.39</mark> | (79)         |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77           | ×      | 9                          | x        | 69.27                      | ĪĪ                  | 0.63         | ×                   | 0.7                  | =      | 190.52               | (79)         |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77           | Ī×     | 9                          | T x      | 44.07                      | i i                 | 0.63         | ×                   | 0.7                  | =      | 121.22               | (79)         |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77           | Ī×     | 9                          | ×        | 31.49                      | ίĒ                  | 0.63         | ×                   | 0.7                  |        | 86.61                | (79)         |
|  |                |        |                            |          |                            |                     |              |                     |                      |        |                      |              |
| Sola <mark>r gains in</mark>           | watts, calcul  | ated   | for each mo                | nth      |                            | (83)m =             | = Sum(74)m . | <mark>(8</mark> 2)m |                      |        |                      |              |
| (83)m= 114.72                          | 199.9 285      | 5.44   | 373.66 436.                | 77 4     | 41.64 422.45               | 374.1               | 3 315.79     | 224.15              | 138.22               | 97.65  |                      | (83)         |
| Total gains – i                        | nternal and s  | solar  | (84)m = (73)               | m + (    | 83)m , watts               |                     |              |                     |                      |        |                      |              |
| (84)m= 401.28                          | 484.26 559     | 9.45   | 631.41 678.                | 29 6     | 67.26 637.93               | 594.9               | 97 545.1     | 469.88              | 402.76               | 376.15 |                      | (84)         |
| 7. Mean inte                           | rnal temperat  | ture ( | (heating seas              | son)     |                            |                     |              |                     |                      |        |                      |              |
| Temperature                            | during heati   | ng p   | eriods in the              | living   | area from Tal              | ble 9, <sup>·</sup> | Th1 (°C)     |                     |                      |        | 21                   | (85)         |
| Utilisation fac                        | ctor for gains | for li | iving area, h <sup>.</sup> | 1,m (s   | ee Table 9a)               |                     |              |                     |                      |        |                      |              |
| Jan                                    | Feb M          | 1ar    | Apr M                      | ay       | Jun Jul                    | Au                  | g Sep        | Oct                 | Nov                  | Dec    |                      |              |
| (86)m= 0.99                            | 0.98 0.5       | 96     | 0.89 0.7                   | 5        | 0.56 0.41                  | 0.46                | 0.71         | 0.93                | 0.99                 | 1      |                      | (86)         |
| Mean interna                           | l temperatur   | e in l | iving area T               | (follo   | ow steps 3 to 7            | 7 in Ta             | able 9c)     |                     |                      |        |                      |              |
| (87)m= 19.85                           | <u> </u>       | .35    | 20.68 20.8                 | <u> </u> | 20.98 21                   | 20.9                | <u> </u>     | 20.64               | 20.18                | 19.81  |                      | (87)         |
|  | during heati   | na na  | eriods in rest             | of dv    | velling from Ta            | hle 9               | <br>Th2 (°C) |                     |                      |        |                      |              |
| (88)m= 19.92                           | 1 <u> </u>     | .92    | 19.94 19.9                 |          | 19.95 19.95                | 19.9                |              | 19.94               | 19.93                | 19.93  |                      | (88)         |
|  |                |        |                            |          |                            |                     |              | -                   | 1                    |        | l                    |              |
| (89)m= 0.99                            | <u> </u>       | for r  | 0.86 0.6                   | <u> </u> | ,m (see Table<br>0.48 0.32 | 9a)<br>0.36         | 0.62         | 0.9                 | 0.98                 | 0.99   |                      | (89)         |
|  |                |        |                            |          |                            |                     |              |                     | 0.90                 | 0.99   |                      | (00)         |
| Mean interna                           | I temperatur   | - 1    | 1                          |          | T2 (follow ste             | r –                 | - I I        | ,                   |                      | 40.0-  | l                    | (00)         |
| (00)                                   | 1 40 - 0 -     | 40 '   |                            |          |                            |                     |              |                     | 1 10 0               | 10 00  |                      |              |
| (90)m= 18.41                           | 18.72 19       | .13    | 19.59 19.8                 | 34       | 19.94 19.95                | 19.9                |              | 19.55               | 18.9<br>ng area ÷ (4 | 18.36  | 0.5                  | (90)<br>(91) |

| Moon internal tompo  | ratura (fa  | r tho wh   | olo dwol  | lling) – fl                                      |   | . (1 fl  | Δ) <del>γ</del> Τ2  |   |  |  |                          |   |
|--|---|--|---|--|---|--|---|---|--|--|--------------------------|---|
| Mean internal tempe<br>(92)m= 19.14 19.4   | 19.75   | 20.14  | 20.37   | 20.46  | 20.47                                   | + (1 – 1L<br>20.47   | 20.42   | 20.1  | 19.55  | 19.09  |                          | (92)  |
| Apply adjustment to  |   |  |   |  | -                                       | _  |   |   |  |  |                          | · · ·   |
| (93)m= 19.14 19.4  | 19.75   | 20.14  | 20.37   | 20.46  | 20.47                                   | 20.47  | 20.42   | 20.1  | 19.55  | 19.09  |                          | (93)  |
| 8. Space heating req   | uirement  |  |   |  |   |  |   |   |  |  |                          |   |
| Set Ti to the mean in  |   |  |   | ed at ste  | ep 11 of                                | Table 9  | o, so tha   | t Ti,m=(  | 76)m an  | d re-calc  | ulate                    |   |
| the utilisation factor f   | 1 <sup>–</sup> –  | <u> </u>   |   |  |   |  |   |   |  | _  |                          |   |
| Jan Feb  | Mar   | Apr  | Мау   | Jun  | Jul                                     | Aug  | Sep   | Oct   | Nov  | Dec  |                          |   |
| Utilisation factor for g<br>(94)m= 0.99 0.98   | ains, nm  | 0.86   | 0.71  | 0.52   | 0.36                                    | 0.41   | 0.66  | 0.9   | 0.98   | 0.99   |                          | (94)  |
| Useful gains, hmGm   |   |  |   | 0.52   | 0.30                                    | 0.41   | 0.00  | 0.9   | 0.90   | 0.99   |                          | (04)  |
| (95)m= 397.24 472.88   | , VV <u>– (</u> 9.  | 545.2  | 484.05  | 345.93   | 232.44                                  | 243.21   | 360.14  | 425.24  | 394.25   | 373.29   |                          | (95)  |
| Monthly average exte   |   |  |   |  |   |  |   | .20.2 .   | 001120   | 010120   |                          | ( )   |
| (96)m= 4.3 4.9   | 6.5   | 8.9  | 11.7  | 14.6   | 16.6                                    | 16.4   | 14.1  | 10.6  | 7.1  | 4.2  |                          | (96)  |
| Heat loss rate for me  | an intern   | al tempe   | erature,  | Lm , W =   | i<br>=[(39)m :                          | r [(93)m   | – (96)m   | ]   |  |  |                          |   |
| (97)m= 920.96 897.48   | 818.15  | 685.66   | 528.03  | 353.11   | 233.44                                  | 244.96   | 382.6   | -<br>578.51   | 761.27   | 915.21   |                          | (97)  |
| Space heating requir   | ement fo  | r each m   | nonth, k\   | Nh/mon   | th = 0.02                               | 24 x [(97)   | )m – (95  | )m] x (4′   | 1)m  |  |                          |   |
| (98)m= 389.65 285.33   | 215.58  | 101.13   | 32.73   | 0  | 0                                       | 0  | 0   | 114.03  | 264.26   | 403.19   |                          |   |
|  |   |  |   |  | -                                       | Tota   | l per year  | (kWh/year   | ) = Sum(9  | 8)15,912 =   | 1805.89                  | (98)  |
| Space heating requir   | ement in  | kWh/m <sup>2</sup>   | /year   |  |   |  |   |   |  |  | 34.93                    | (99)  |
| 9a. Energy requireme   | nts – Ind   | ividu <mark>al h</mark>  | eating s  | vstems i   | ncluding                                | micro-C  | HP)   |   |  |  |                          |   |
| Space heating:   |   | vide ai ii   |   | yotorno r  |   |  |   |   |  |  |                          |   |
| Fraction of space he   | at from s   | econdary   | v/sunnle  | mentary  |   |  |   |   |  |  | 0                        | (201)   |
|  |   |  | yrouppic  | memary   | system                                  |  |   |   |  |  | 0                        | (201)   |
| Fraction of space he   | at from m   |  |   | mentary  |   | (202) = 1 -  | - (201) =   |   |  |  | 1                        | (201)   |
|  |   | nain syst  | em(s)   | mentary  |   | (202) = 1 -<br>(204) = (20                                     |   | (203)] =  |  |  |                          |   |
| Fraction of total heat   | ing from  | nain syst<br>main sys  | em(s)<br>stem 1   | mentary  |   |  |   | (203)] =  |  |  | 1                        | (202)<br>(204)  |
| Fraction of total heat<br>Efficiency of main sp  | ing from<br>ace heat  | nain syst<br>main sys<br>ing syste   | em(s)<br>stem 1<br>em 1   |  |   |  |   | (203)] =  |  |  | 1                        | (202)<br>(204)<br>(206)   |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda   | ing from<br>ace heat<br>ary/supple  | nain syst<br>main sys<br>ing syste<br>ementar  | em(s)<br>stem 1<br>em 1<br>y heating  | g system   | n, %                                    | (204) = (2   | 02) × [1 –  |   | Nov  | Dec  | 1<br>1<br>93.4<br>0      | (202)<br>(204)<br>(206)<br>(208)  |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb  | ing from<br>ace heat<br>ary/suppl<br>Mar  | nain syst<br>main sys<br>ing syste<br>ementar<br>Apr   | em(s)<br>stem 1<br>em 1<br>y heating<br>May   | g system   |   |  |   | (203)] =<br>Oct   | Nov  | Dec  | 1<br>1<br>93.4           | (202)<br>(204)<br>(206)<br>(208)  |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda   | ing from<br>ace heat<br>ary/suppl<br>Mar  | nain syst<br>main sys<br>ing syste<br>ementar<br>Apr   | em(s)<br>stem 1<br>em 1<br>y heating<br>May   | g system   | n, %                                    | (204) = (2   | 02) × [1 –  |   | Nov<br>264.26  | Dec<br>403.19                                      | 1<br>1<br>93.4<br>0      | (202)<br>(204)<br>(206)<br>(208)  |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33   | ing from<br>ace heat<br>ary/supple<br>Mar<br>ement (c<br>215.58   | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73  | g system   | n, %                                    | (204) = (2<br>Aug  | 02) × [1 –<br>Sep   | Oct   |  |  | 1<br>1<br>93.4<br>0      | (202)<br>(204)<br>(206)<br>(208)<br>ear                                       |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir  | ing from<br>ace heat<br>ary/supple<br>Mar<br>ement (c<br>215.58   | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73  | g system   | n, %                                    | (204) = (2<br>Aug  | 02) × [1 –<br>Sep   | Oct   |  |  | 1<br>1<br>93.4<br>0      | (202)<br>(204)<br>(206)<br>(208)  |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)  | ing from<br>ace heat<br>ary/supple<br>Mar<br>cement (c<br>215.58<br>(24)] } x 1   | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13<br>00 ÷ (20   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73  | g system<br>Jun<br>)<br>0                        | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0   | 02) × [1 -<br>Sep<br>0                                    | Oct<br>114.03<br>122.09   | 264.26<br>282.93   | 403.19<br>431.68                                   | 1<br>1<br>93.4<br>0      | (202)<br>(204)<br>(206)<br>(208)<br>ear                                       |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20<br>417.18 305.5   | ing from<br>ace heat<br>ary/supple<br>Mar<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81  | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13<br>00 ÷ (20<br>108.28   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73<br>06)<br>35.04                          | g system<br>Jun<br>)<br>0                        | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0   | 02) × [1 -<br>Sep<br>0                                    | Oct<br>114.03<br>122.09   | 264.26<br>282.93   | 403.19<br>431.68                                   | 1<br>93.4<br>0<br>kWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>ear                                       |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)  | ing from<br>ace heat<br>ary/supple<br>Mar<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81  | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13<br>00 ÷ (20<br>108.28   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73<br>06)<br>35.04                          | g system<br>Jun<br>)<br>0                        | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0   | 02) × [1 -<br>Sep<br>0                                    | Oct<br>114.03<br>122.09   | 264.26<br>282.93   | 403.19<br>431.68                                   | 1<br>93.4<br>0<br>kWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>ear                                       |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20<br>417.18 305.5]  | ing from<br>ace heat<br>ary/supple<br>Mar<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81  | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13<br>00 ÷ (20<br>108.28   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73<br>06)<br>35.04                          | g system<br>Jun<br>)<br>0                        | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0   | 02) × [1 -<br>Sep<br>0                                    | Oct<br>114.03<br>122.09   | 264.26<br>282.93   | 403.19<br>431.68                                   | 1<br>93.4<br>0<br>kWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>ear                                       |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)]<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (20)   | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81<br>secondar<br>100 ÷ (20  | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73<br>06)<br>35.04<br>month                 | g system<br>Jun<br>)<br>0                        | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota                                 | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea                   | Oct<br>114.03<br>122.09<br>ar) =Sum(2<br>0                              | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0   | 403.19<br>431.68<br>-                              | 1<br>93.4<br>0<br>kWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>ear                                       |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)]<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (20)   | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81<br>secondar<br>100 ÷ (20  | nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)   | em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above)<br>32.73<br>06)<br>35.04<br>month                 | g system<br>Jun<br>)<br>0                        | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota                                 | 02) × [1 -<br>Sep<br>0<br>0<br>I (kWh/yea                 | Oct<br>114.03<br>122.09<br>ar) =Sum(2<br>0                              | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0   | 403.19<br>431.68<br>-                              | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)                   |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)]}<br>(211)m = {[(98)m x (20)]} x (20)<br>(215)m 0 0<br>Water heating<br>Output from water heat   | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81<br>(20) ÷ (20)<br>0<br>(0)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)  | nain syst<br>main syst<br>ing syste<br>ementary<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)<br>0  | em(s)<br>stem 1<br>em 1<br>y heating<br>d above)<br>32.73<br>06)<br>35.04<br>month<br>0                   | g system<br>Jun<br>0                             | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota                    | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea<br>I (kWh/yea     | Oct<br>114.03<br>122.09<br>ar) = Sum(2<br>0<br>ar) = Sum(2              | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 403.19<br>431.68<br>=<br>0                         | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)                   |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (215)m = 0 0<br>Water heating<br>Output from water heat<br>165.55 144.61   | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81<br>(230.81)<br>(20) ÷ (20)<br>(10) ÷ (20)<br>(20) ÷ (20)<br>(150.46)  | nain syst<br>main syst<br>ing syste<br>ementar<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)<br>0   | em(s)<br>stem 1<br>em 1<br>y heating<br>d above)<br>32.73<br>06)<br>35.04<br>month<br>0                   | g system<br>Jun<br>)<br>0                        | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota                                 | 02) × [1 -<br>Sep<br>0<br>0<br>I (kWh/yea                 | Oct<br>114.03<br>122.09<br>ar) =Sum(2<br>0                              | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0   | 403.19<br>431.68<br>=<br>0                         | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)<br>(211)          |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (215)m = 0 0<br>Water heating<br>Output from water heat<br>165.55 144.61<br>Efficiency of water heat   | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81<br>(20) ÷ (20)<br>0<br>(150.46<br>ater  | nain syst<br>main syst<br>ing syste<br>ementary<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)<br>0<br>ulated al<br>133.45   | em(s)<br>stem 1<br>em 1<br>y heating<br>d above)<br>32.73<br>06)<br>35.04<br>month<br>0                   | g system<br>Jun<br>)<br>0<br>0<br>113.79         | n, %<br>Jul<br>0<br>0                   | (204) = (2)<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54         | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea<br>122.88         | Oct<br>114.03<br>122.09<br>ar) = Sum(2<br>0<br>ar) = Sum(2<br>139.92    | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>149.36          | 403.19<br>431.68<br>=<br>0<br>=<br>161.66          | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)<br>(211)<br>(215) |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (215)m = 0 0<br>Water heating<br>Output from water heat<br>165.55 144.61<br>Efficiency of water heat<br>(217)m = 87.13 86.73                                  | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>04)] } x 1<br>230.81<br>secondar<br>00 ÷ (20<br>0<br>150.46<br>ater<br>85.96  | nain syst<br>main syst<br>ing syste<br>ementar<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)<br>0<br>ulated al<br>133.45<br>84.36   | em(s)<br>stem 1<br>em 1<br>y heating<br>d above)<br>32.73<br>06)<br>35.04<br>month<br>0                   | g system<br>Jun<br>0                             | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota                    | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea                   | Oct<br>114.03<br>122.09<br>ar) = Sum(2<br>0<br>ar) = Sum(2              | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 403.19<br>431.68<br>=<br>0                         | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)<br>(211)          |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (215)m = 0 0<br>Water heating<br>Output from water heat<br>165.55 144.61<br>Efficiency of water heat<br>(217)m = 87.13 86.73<br>Fuel for water heating        | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81<br>(230.81<br>(200 ÷ (20)<br>0<br>(200 ÷ (20)<br>0<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20 | ain syst<br>main syst<br>ing syste<br>ementary<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)<br>0<br>ulated al<br>133.45<br>84.36<br>onth   | em(s)<br>stem 1<br>em 1<br>y heating<br>d above)<br>32.73<br>06)<br>35.04<br>month<br>0                   | g system<br>Jun<br>)<br>0<br>0<br>113.79         | n, %<br>Jul<br>0<br>0                   | (204) = (2)<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54         | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea<br>122.88         | Oct<br>114.03<br>122.09<br>ar) = Sum(2<br>0<br>ar) = Sum(2<br>139.92    | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>149.36          | 403.19<br>431.68<br>=<br>0<br>=<br>161.66          | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)<br>(211)<br>(215) |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20)<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (215)m = 0 0<br>Water heating<br>Output from water heat<br>165.55 144.61<br>Efficiency of water heat<br>(217)m = 87.13 86.73                                  | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] } x 1<br>230.81<br>(230.81<br>(200 ÷ (20)<br>0<br>(200 ÷ (20)<br>0<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20 | ain syst<br>main syst<br>ing syste<br>ementary<br>alculated<br>101.13<br>00 ÷ (20<br>108.28<br>y), kWh/<br>8)<br>0<br>ulated al<br>133.45<br>84.36<br>onth   | em(s)<br>stem 1<br>em 1<br>y heating<br>d above)<br>32.73<br>06)<br>35.04<br>month<br>0                   | g system<br>Jun<br>)<br>0<br>0<br>113.79         | n, %<br>Jul<br>0<br>0                   | (204) = (2)<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54         | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea<br>122.88         | Oct<br>114.03<br>122.09<br>ar) = Sum(2<br>0<br>ar) = Sum(2<br>139.92    | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>149.36          | 403.19<br>431.68<br>=<br>0<br>=<br>161.66          | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)<br>(211)<br>(215) |
| Fraction of total heat<br>Efficiency of main sp<br>Efficiency of seconda<br>Jan Feb<br>Space heating requir<br>389.65 285.33<br>(211)m = {[(98)m x (20<br>417.18 305.5<br>Space heating fuel (s<br>= {[(98)m x (201)] } x (215)m = 0 0<br>Water heating<br>Output from water heating<br>Output from water heating<br>(217)m 87.13 86.73<br>Fuel for water heating<br>(219)m = (64)m x 10 | ing from<br>ace heat<br>ary/supple<br>ement (c<br>215.58<br>(24)] $\}$ x 1<br>230.81<br>(230.81)<br>(20) $\div$ (20)<br>(20) $\div$ (20)<br>(20) $\div$ (20)<br>(20) $\div$ (20)<br>(20) $\div$ (217)<br>(20) $\div$ (217)<br>(217) $\div$ (217)  | nain         systematic           main         systematic           ing         systematic           ementary         Apr           alculated         101.13           00 ÷ (20         108.28           y), kWh/         0           8)         0           ulated         al           133.45         84.36           onth         m | em(s)<br>stem 1<br>em 1<br>y heating<br>d above)<br>32.73<br>06)<br>35.04<br>month<br>0<br>129.2<br>82.16 | g system<br>Jun<br>)<br>0<br>0<br>113.79<br>80.3 | n, %<br>Jul<br>0<br>0<br>109.02<br>80.3 | (204) = (2)<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54<br>80.3 | 02) × [1<br>Sep<br>0<br>0<br>1 (kWh/yea<br>122.88<br>80.3 | Oct<br>114.03<br>122.09<br>ar) =Sum(2<br>0<br>139.92<br>84.54<br>165.51 | 264.26<br>282.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>149.36<br>86.47 | 403.19<br>431.68<br>=<br>0<br>=<br>161.66<br>87.26 | 1<br>93.4<br>0<br>KWh/ye | (202)<br>(204)<br>(206)<br>(208)<br>(208)<br>(211)<br>(211)<br>(211)<br>(215) |

| Annual totals   |                                 | kWh/year                    | г   | kWh/year                       | 1      |
|---|---------------------------------|-----------------------------|-----|--------------------------------|--------|
| Space heating fuel used, main system 1                          |                                 |                             | L   | 1933.5                         |        |
| Water heating fuel used   |                                 |                             |     | 1952.58                        |        |
| Electricity for pumps, fans and electric keep-hot               |                                 |                             |     |                                |        |
| central heating pump:   |                                 | [                           | 30  |                                | (230c) |
| boiler with a fan-assisted flue                                 |                                 | [                           | 45  |                                | (230e) |
| Total electricity for the above, kWh/year                       | sum of (230a)                   | (230g) =                    | [   | 75                             | (231)  |
| Electricity for lighting  |                                 |                             |     | 238.76                         | (232)  |
| 12a. CO2 emissions – Individual heating systems                 | including micro-CHP             |                             |     |                                |        |
|   | <b>Energy</b><br>kWh/year       | Emission fact<br>kg CO2/kWh | or  | <b>Emissions</b><br>kg CO2/yea | r      |
| Space heating (main system 1)                                   | (211) x                         | 0.216                       | =   | 417.64                         | (261)  |
| Space heating (secondary)                                       | (215) x                         | 0.519                       | =   | 0                              | (263)  |
| Water heating   | (219) x                         | 0.216                       | =   | 421.76                         | (264)  |
| Space and water heating   | (261) + (262) + (263) + (264) = |                             | [   | 839.39                         | (265)  |
| Elec <mark>tricity for pumps, fans and</mark> electric keep-hot | (231) x                         | 0.519                       | =   | 38.93                          | (267)  |
| Electricity for lighting  | (232) x                         | 0.519                       | - [ | 123.92                         | (268)  |
| Total CO2, kg/year  | sum o                           | of (265)…(271) =            |     | 1002.23                        | (272)  |
| TER =   |                                 |                             | L   | 19.39                          | (273)  |

|  |  |                        | User D            | etails:                      |            |               |                       |           |                                       |                  |
|--|--|------------------------|-------------------|------------------------------|------------|---------------|-----------------------|-----------|---------------------------------------|------------------|
| Assessor Name:<br>Software Name:                           | Stroma FSAP 201  |                        |                   | Stroma<br>Softwa<br>Address: | re Ver     |               |                       | Versio    | on: 1.0.4.23                          |                  |
| Address :  | 2 Bed Flat, 219-223                                      |                        |                   |                              |            | ah Junct      | tion. LON             | NDON      |                                       |                  |
| 1. Overall dwelling dime                                   |  |                        |                   | ,                            |            | ,             | ,                     |           |                                       |                  |
| Ground floor   |  |                        |                   | <b>a(m²)</b><br>77.9         | (1a) x     | <b></b>       | <b>ight(m)</b><br>2.5 | (2a) =    | <b>Volume(m<sup>3</sup></b><br>194.75 | <b>)</b><br>(3a) |
| Total floor area TFA = (1a                                 | a)+(1b)+(1c)+(1d)+(1e                                    | e)+(1n)                | ) 7               | 7.9                          | (4)        |               |                       |           |                                       |                  |
| Dwelling volume  |  |                        |                   |                              | (3a)+(3b)  | +(3c)+(3c     | d)+(3e)+              | .(3n) =   | 194.75                                | (5)              |
| 2. Ventilation rate:                                       |  |                        |                   |                              |            |               |                       |           |                                       |                  |
| Number of chimneys   | main so<br>heating h                                     | econdary<br>leating    | /<br>] + [_       | other<br>0                   | ] = [      | total<br>0    | X 4                   | 40 =      | m <sup>3</sup> per hou                | r<br>(6a)        |
| Number of open flues                                       | 0 +  | 0                      | ] + [             | 0                            | ] = [      | 0             | x                     | 20 =      | 0                                     | (6b)             |
| Number of intermittent fa                                  | ns   |                        | J L_              |                              | , г<br>Г   | 3             | x /                   | 10 =      | 30                                    | (7a)             |
| Number of passive vents                                    |  |                        |                   |                              | Γ          | 0             | <b>x</b> ′            | 10 =      | 0                                     | (7b)             |
| Number of flueless gas fi                                  | res  |                        |                   |                              | Ē          | 0             | X 4                   | 40 =      | 0                                     | (7c)             |
|  |  |                        |                   |                              |            |               |                       | Air ch    | anges per ho                          | our              |
| Infiltration due to chimney                                |  |                        |                   |                              |            | 30            |                       | ÷ (5) =   | 0.15                                  | (8)              |
| Number of storeys in the<br>Additional infiltration        |  | u, proceeu             | <i>io (17),</i> c |                              | onunue m   | 0111 (9) to ( |                       | -1]x0.1 = | 0                                     | (9)<br>(10)      |
| Structural infiltration: 0.                                |  |                        |                   |                              | •          | uction        |                       |           | 0                                     | (11)             |
| deducting areas of openir                                  | resent, use the value corres<br>ngs); if equal user 0.35 | ponding to             | ine greate        | er wall area                 | a (aner    |               |                       |           |                                       |                  |
| If suspended wooden f                                      | loor, enter 0.2 (unseal                                  | ed) or 0. <sup>-</sup> | 1 (seale          | d), else                     | enter 0    |               |                       |           | 0                                     | (12)             |
| If no draught lobby, en                                    | ter 0.05, else enter 0                                   |                        |                   |                              |            |               |                       |           | 0                                     | (13)             |
| Percentage of windows                                      | s and doors draught st                                   | ripped                 |                   |                              |            |               |                       |           | 0                                     | (14)             |
| Window infiltration  |  |                        |                   | 0.25 - [0.2                  |            |               |                       |           | 0                                     | (15)             |
| Infiltration rate  |  |                        |                   | (8) + (10) -                 |            | · · · ·       |                       |           | 0                                     | (16)             |
| Air permeability value,                                    | •  |                        | •                 | •                            |            | etre of e     | envelope              | area      | 5                                     | (17)             |
| If based on air permeabil<br>Air permeability value applie |  |                        |                   |                              |            | ia haina u    | and                   |           | 0.4                                   | (18)             |
| Number of sides sheltere                                   |  | s been done            | e or a deg        | liee all pei                 | meaning    | is being u    | seu                   |           | 2                                     | (19)             |
| Shelter factor   | 4  |                        |                   | (20) = 1 - [                 | 0.075 x (1 | 9)] =         |                       |           | 0.85                                  | (20)             |
| Infiltration rate incorporat                               | ing shelter factor                                       |                        |                   | (21) = (18)                  | x (20) =   |               |                       |           | 0.34                                  | (21)             |
| Infiltration rate modified for                             | or monthly wind speed                                    | ł                      |                   |                              |            |               |                       |           |                                       |                  |
| Jan Feb  | Mar Apr May  | Jun                    | Jul               | Aug                          | Sep        | Oct           | Nov                   | Dec       |                                       |                  |
| Monthly average wind sp                                    | eed from Table 7   |                        |                   |                              |            |               |                       |           |                                       |                  |
| (22)m= 5.1 5   | 4.9 4.4 4.3  | 3.8                    | 3.8               | 3.7                          | 4          | 4.3           | 4.5                   | 4.7       |                                       |                  |
| Wind Factor (22a)m = (22                                   | 2)m ÷ 4  |                        |                   |                              |            |               |                       |           |                                       |                  |
| (22a)m= 1.27 1.25  | 1.23 1.1 1.08  | 0.95                   | 0.95              | 0.92                         | 1          | 1.08          | 1.12                  | 1.18      |                                       |                  |
|  |  |                        |                   |                              |            |               |                       |           |                                       |                  |

| Adjuste            | ed infiltr            | ation rat         | e (allow                   | ing for sh                 | elter an     | d wind s     | peed) =     | (21a) x       | (22a)m              |               |                  |           |          |                |
|--------------------|-----------------------|-------------------|----------------------------|----------------------------|--------------|--------------|-------------|---------------|---------------------|---------------|------------------|-----------|----------|----------------|
|                    | 0.44                  | 0.43              | 0.42                       | 0.38                       | 0.37         | 0.33         | 0.33        | 0.32          | 0.34                | 0.37          | 0.39             | 0.4       |          |                |
|                    | ate etteo<br>echanica |                   | •                          | rate for t                 | he applic    | cable ca     | se          |               |                     |               |                  |           | 0        | (23a)          |
|                    |                       |                   |                            | endix N, (2                | 3b) = (23a   | ) × Fmv (e   | equation (I | N5)) , othe   | rwise (23b          | ) = (23a)     |                  |           | 0        | (23b)          |
| If bala            | anced with            | heat reco         | overy: effic               | ciency in %                | allowing for | or in-use fa | actor (fron | n Table 4h    | ) =                 |               |                  |           | 0        | (23c)          |
| a) If              | balance               | d mech            | anical ve                  | entilation                 | with hea     | at recove    | əry (MVI    | HR) (24a      | a)m = (22           | 2b)m + (      | 23b) × [*        | 1 – (23c) | -        | ()             |
| (24a)m=            |                       | 0                 | 0                          | 0                          | 0            | 0            | 0           | 0             | 0                   | 0             | 0                | 0         |          | (24a)          |
| b) If              | balance               | d mech            | anical ve                  | entilation                 | without      | heat rec     | covery (N   | u<br>MV) (24t | )m = (22            | 2b)m + (2     | 23b)             |           |          |                |
| (24b)m=            | 0                     | 0                 | 0                          | 0                          | 0            | 0            | 0           | 0             | 0                   | 0             | 0                | 0         |          | (24b)          |
| c) If              | whole h               | ouse ex           | tract ver                  | ntilation c                | or positiv   | e input v    | ventilatio  | n from o      | outside             |               |                  | !         |          |                |
| i                  | if (22b)n             | n < 0.5 >         | <b>&lt;</b> (23b), t       | then (24c                  | c) = (23b    | ); otherv    | wise (24    | c) = (22      | o) m + 0.           | 5 × (23b      | )                |           |          |                |
| (24c)m=            | 0                     | 0                 | 0                          | 0                          | 0            | 0            | 0           | 0             | 0                   | 0             | 0                | 0         |          | (24c)          |
| ,                  |                       |                   |                            | ole hous                   | •            | •            |             |               |                     | 0.51          |                  |           |          |                |
| (24d)m=            | · ,                   | n = 1, tn<br>0.59 | en (24d)<br>0.59           | m = (22k)                  | 0.57         | 1WISE (2     | 40)m =      | 0.5 + [(2     | 2D)m <sup>2</sup> X | 0.5]          | 0.57             | 0.58      | l        | (24d)          |
|                    |                       |                   |                            |                            |              |              |             |               |                     | 0.57          | 0.57             | 0.56      |          | (240)          |
| (25)m=             |                       | 0.59              | 0.59                       | nter (24a)                 | 0.57         | 0.55         | 0.55        |               | 0.56                | 0.57          | 0.57             | 0.58      |          | (25)           |
| (23)11-            | 0.0                   | 0.33              | 0.55                       | 0.37                       | 0.01         | 0.55         | 0.00        | 0.00          | 0.50                | 0.57          | 0.57             | 0.00      |          | (20)           |
| 3. He              | at losse              | s and he          | eat loss                   | paramete                   |              |              |             |               |                     |               |                  |           |          |                |
| ELEN               |                       | Gro:<br>area      |                            | Openin                     | -            | Net Ar       |             | U-val<br>W/m2 |                     | A X U<br>(W/I | <b>(</b> )       | k-value   |          | A X k<br>kJ/K  |
| Windo              | ws Type               |                   | ()                         |                            |              | 9.45         |             | /[1/( 1.4 )+  |                     | 12.53         |                  |           |          | (27)           |
|                    | ws Type               |                   |                            |                            |              | 3.15         | =           | /[1/( 1.4 )+  |                     | 4.18          | Ħ                |           |          | (27)           |
| Walls <sup>-</sup> |                       | 10.0              | 15                         | 9.45                       |              | 0.6          |             | 0.18          |                     | 0.11          | Fi r             |           |          | (29)           |
| Walls -            |                       | 14.               |                            | 0.10                       | =            | 14.5         |             | 0.18          |                     | 2.61          | ╘┤┟              |           | = -      | (29)           |
| Walls <sup>-</sup> |                       | 5.3               |                            | 3.15                       |              | 2.2          |             | 0.18          |                     | 0.4           | ╡╏               |           | $\dashv$ | (29)           |
|                    | rea of e              |                   |                            | 0.10                       |              | 29.9         |             | 0.10          |                     | 0.4           | L                |           |          | (20)           |
| Party v            |                       |                   | ,                          |                            |              | 32           | x           | 0             | = [                 | 0             | r                |           |          | (32)           |
| Party v            |                       |                   |                            |                            |              | 32           |             |               |                     | 0             | ╡╏               |           | $\dashv$ | (32)           |
| Party f            |                       |                   |                            |                            |              | 77.9         |             | 0             |                     | 0             | L<br>r           |           | $\dashv$ | (32a)          |
| Party c            |                       |                   |                            |                            |              | 77.9         |             |               |                     |               | L                |           | $\dashv$ | (32a)<br>(32b) |
| -                  | al wall **            |                   |                            |                            |              | 82.5         |             |               |                     |               | L                |           | $\dashv$ | (32b)<br>(32c) |
|                    |                       |                   | lows. use e                | effective wil              | ndow U-va    |              |             | a formula 1   | /[(1/U-valu         | ıe)+0.041 a   | L<br>Is aiven in | paragraph | L        | (020)          |
|                    |                       |                   |                            | nternal wall               |              |              |             | ,             |                     | ,,.           | - <b>J</b>       | p 9 p     |          |                |
| Fabric             | heat los              | s, W/K            | = S (A x                   | U)                         |              |              |             | (26)(30       | ) + (32) =          |               |                  |           | 19.8     | 32 (33)        |
| Heat c             | apacity               | Cm = S            | (A x k )                   |                            |              |              |             |               | ((28)               | .(30) + (32   | 2) + (32a).      | (32e) =   | 15893    | 3.1 (34)       |
| Therm              | al mass               | parame            | eter (TMI                  | P = Cm ÷                   | - TFA) in    | ⊨kJ/m²K      |             |               | Indica              | tive Value    | Medium           |           | 250      | ) (35)         |
|                    | -                     |                   | nere the de<br>tailed calc | etails of the<br>rulation. | constructi   | on are not   | t known pi  | recisely the  | e indicative        | e values of   | TMP in Ta        | able 1f   |          |                |
| Therm              | al bridge             | es : S (L         | . x Y) cal                 | lculated u                 | using Ap     | pendix ł     | <           |               |                     |               |                  |           | 4.64     | 4 (36)         |
|                    |                       |                   | are not kr                 | nown (36) =                | = 0.05 x (3  | 1)           |             |               |                     |               |                  |           |          |                |
| I otal fa          | abric he              | at loss           |                            |                            |              |              |             |               | (33) +              | (36) =        |                  |           | 24.4     | 6 (37)         |

| Ventila     | ation hea              | t loss ca    | alculated | monthl            | у              |             |            |                        | (38)m                 | = 0.33 × (        | 25)m x (5)                            |         |         |              |
|-------------|------------------------|--------------|-----------|-------------------|----------------|-------------|------------|------------------------|-----------------------|-------------------|---------------------------------------|---------|---------|--------------|
|             | Jan                    | Feb          | Mar       | Apr               | May            | Jun         | Jul        | Aug                    | Sep                   | Oct               | Nov                                   | Dec     |         |              |
| (38)m=      | 38.3                   | 38.06        | 37.82     | 36.72             | 36.51          | 35.55       | 35.55      | 35.38                  | 35.92                 | 36.51             | 36.93                                 | 37.37   |         | (38)         |
| Heat t      | ransfer c              | oefficier    | nt, W/K   |                   |                |             |            |                        | (39)m                 | = (37) + (        | 38)m                                  |         |         |              |
| (39)m=      | 62.75                  | 62.51        | 62.28     | 61.17             | 60.97          | 60.01       | 60.01      | 59.83                  | 60.38                 | 60.97             | 61.39                                 | 61.82   |         | _            |
|             |                        |              |           | /2021             |                |             |            |                        |                       | -                 | Sum(39) <sub>1.</sub>                 | 12 /12= | 61.17   | (39)         |
| (40)m=      | oss para               | 0.8          | 1LP), VV  | 0.79              | 0.78           | 0.77        | 0.77       | 0.77                   | 0.78                  | = (39)m ÷<br>0.78 | 0.79                                  | 0.79    |         |              |
| (40)11-     | 0.01                   | 0.0          | 0.0       | 0.75              | 0.70           | 0.11        | 0.77       | 0.11                   |                       |                   | Sum(40)1.                             |         | 0.79    | (40)         |
| Numb        | er of day              | rs in moi    | nth (Tab  | le 1a)            |                |             |            |                        |                       |                   |                                       |         |         |              |
|             | Jan                    | Feb          | Mar       | Apr               | May            | Jun         | Jul        | Aug                    | Sep                   | Oct               | Nov                                   | Dec     |         |              |
| (41)m=      | 31                     | 28           | 31        | 30                | 31             | 30          | 31         | 31                     | 30                    | 31                | 30                                    | 31      |         | (41)         |
|             |                        |              |           |                   |                |             |            |                        |                       |                   |                                       |         |         |              |
| 4. Wa       | ater heat              | ing enei     | rgy requ  | irement:          |                |             |            |                        |                       |                   |                                       | kWh/ye  | ear:    |              |
| Assun       | ned occu               | ipancy       | N         |                   |                |             |            |                        |                       |                   | 2                                     | 42      |         | (42)         |
| if TF       | A > 13.9               | 9, N = 1     |           | : [1 - exp        | (-0.0003       | 849 x (TF   | A -13.9    | )2)] + 0.0             | 0013 x ( <sup>-</sup> | TFA -13.          |                                       | 42      |         | ()           |
|             | A £ 13.9               | ,            | tor upo   | ao in litre       | o por de       | w Vd ov     | orogo –    | (25 v NI)              | 1.26                  |                   |                                       | ]       |         | (10)         |
| Reduce      | the annua              | l average    | hot water | usage by          | 5% if the a    | lwelling is | designed i | (25 x N)<br>to achieve | + 30<br>a water us    | se target o       | f 91                                  | .72     |         | (43)         |
| not mor     | e that 125             | litres per   | person pe | r day (all w      | vater use, l   | hot and co  | ld)        |                        |                       |                   |                                       |         |         |              |
|             | Jan                    | Feb          | Mar       | Apr               | May            | Jun         | Jul        | Aug                    | Sep                   | Oct               | Nov                                   | Dec     |         |              |
| Hot wat     | er usage ii            | n litres per | day for e | ach month         | Vd,m = fa      | ctor from T | Table 1c x | (43)                   |                       |                   |                                       |         |         |              |
| (44)m=      | 100.89                 | 97.22        | 93.55     | 89.88             | 86.21          | 82.55       | 82.55      | 86.21                  | 89.88                 | 93.55             | 97.22                                 | 100.89  |         | <b>-</b>     |
| Energy      | content of             | hot water    | used - ca | culated m         | onthly $= 4$ . | 190 x Vd,r  | n x nm x E | 0Tm / 3600             |                       |                   | m(44) <sub>112</sub> =<br>ables 1b, 1 | L       | 1100.62 | (44)         |
| (45)m=      | 149.62                 | 130.86       | 135.03    | 117.72            | 112.96         | 97.47       | 90.32      | 103.65                 | 104.89                | 122.24            | 133.43                                | 144.9   |         |              |
|             |                        |              |           |                   |                |             |            |                        |                       | Total = Su        | m(45) <sub>112</sub> =                |         | 1443.08 | (45)         |
|             |                        |              | <u> </u>  | · · ·             |                |             |            | boxes (46)             |                       | r                 | i                                     |         |         |              |
|             | 22.44<br>storage       |              | 20.25     | 17.66             | 16.94          | 14.62       | 13.55      | 15.55                  | 15.73                 | 18.34             | 20.01                                 | 21.73   |         | (46)         |
|             | -                      |              | includir  | ng any se         | olar or W      | /WHRS       | storage    | within sa              | ame ves               | sel               |                                       | 0       |         | (47)         |
| If com      | munity h               | eating a     | ind no ta | ank in dw         | velling, e     | nter 110    | litres in  | (47)                   |                       |                   |                                       |         |         |              |
|             |                        |              | hot wate  | er (this ir       | ncludes i      | nstantar    | neous co   | ombi boil              | ers) ente             | er '0' in (       | 47)                                   |         |         |              |
|             | storage                |              | مامتمطا   | a a a fa at       | an ia kwa      |             | (dev)      |                        |                       |                   |                                       |         |         | (10)         |
| ,           |                        |              |           | oss facto         | or is kno      | wn (kvvr    | 1/day):    |                        |                       |                   |                                       | 0       |         | (48)         |
|             | erature fa             |              |           | ⊧ ∠b<br>e, kWh/ye | oor            |             |            | (48) x (49)            | _                     |                   |                                       | 0       |         | (49)         |
| -           |                        |              | -         | cylinder          |                | or is not   |            | (40) × (43)            | -                     |                   |                                       | 0       |         | (50)         |
|             |                        | -            |           | rom Tab           | le 2 (kW       | h/litre/da  | ıy)        |                        |                       |                   |                                       | 0       |         | (51)         |
|             | munity h               | -            |           | on 4.3            |                |             |            |                        |                       |                   |                                       |         |         | ()           |
|             | e factor<br>erature fa |              |           | 2h                |                |             |            |                        |                       |                   |                                       | 0<br>0  |         | (52)<br>(53) |
|             |                        |              |           |                   | aar            |             |            | (47) x (51)            | v (52) v (            | 53) -             |                                       |         |         |              |
| -           | (50) or (              |              | -         | e, kWh/ye         | Jai            |             |            | (10) X (01)            | , (JZ) X (            | 55) =             |                                       | 0<br>0  |         | (54)<br>(55) |
|             |                        |              |           | for each          | month          |             |            | ((56)m = (             | 55) × (41)ı           | m                 | L'                                    | ~       |         | ()           |
| (56)m=      | 0                      | 0            | 0         | 0                 | 0              | 0           | 0          | 0                      | 0                     | 0                 | 0                                     | 0       |         | (56)         |
| · · · · · · | -                      | -            | -         | -                 | -              | -<br>-      | -          | -                      | -                     | -                 | -                                     | -       |         |              |

| If cylinder conta          | ins dedicate             | ed solar sto | rage, (57)ı | m = (56)m | x [(50) – ( | H11)] ÷ (5               | 0), else (5  | 7)m = (56)    | m where (                 | H11) is fro   | m Append    | lix H         |      |
|----------------------------|--------------------------|--------------|-------------|-----------|-------------|--------------------------|--------------|---------------|---------------------------|---------------|-------------|---------------|------|
| (57)m= 0                   | 0                        | 0            | 0           | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           |               | (57) |
| Primary circu              | uit loss (ar             | nnual) fro   | om Table    | e 3       |             |                          |              |               | -                         |               | 0           |               | (58) |
| Primary circu              |                          |              |             |           | 59)m = (    | (58) ÷ 36                | 65 × (41)    | m             |                           |               |             |               |      |
| (modified                  | by factor f              | rom Tab      | le H5 if t  | here is s | solar wat   | ter heatii               | ng and a     | cylinde       | r thermo                  | stat)         |             | L             |      |
| (59)m= 0                   | 0                        | 0            | 0           | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           | _             | (59) |
| Combi loss o               | alculated                | for each     | month (     | (61)m =   | (60) ÷ 36   | 65 × (41)                | )m           |               |                           |               |             |               |      |
| (61)m= 50.96               | 6 44.75                  | 47.67        | 44.33       | 43.93     | 40.71       | 42.06                    | 43.93        | 44.33         | 47.67                     | 47.94         | 50.96       |               | (61) |
| Total heat re              | quired for               | water he     | eating ca   | alculated | l for eacl  | h month                  | (62)m =      | 0.85 × (      | (45)m +                   | (46)m +       | (57)m +     | (59)m + (61)m | 1    |
| (62)m= 200.5               | 8 175.6                  | 182.7        | 162.05      | 156.89    | 138.18      | 132.39                   | 147.58       | 149.21        | 169.91                    | 181.37        | 195.85      |               | (62) |
| Solar DHW inpu             | it calculated            | using App    | endix G or  | Appendix  | H (negati   | ve quantity              | /) (enter '0 | ' if no sola  | r contribut               | ion to wate   | er heating) |               |      |
| (add addition              | al lines if              | FGHRS        | and/or V    | WHRS      | applies     | , see Ap                 | pendix C     | G)            |                           |               |             |               |      |
| (63)m= 0                   | 0                        | 0            | 0           | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           |               | (63) |
| Output from                | water hea                | ater         |             |           |             |                          |              |               |                           |               |             |               |      |
| (64)m= 200.5               | 8 175.6                  | 182.7        | 162.05      | 156.89    | 138.18      | 132.39                   | 147.58       | 149.21        | 169.91                    | 181.37        | 195.85      |               | -    |
|                            |                          |              |             |           |             |                          | Outp         | out from w    | ater heate                | r (annual)₁   | 12          | 1992.33       | (64) |
| Heat gains fi              | om water                 | heating,     | kWh/m       | onth 0.2  | 5 ´ [0.85   | × (45)m                  | + (61)m      | n] + 0.8 >    | k [(46)m                  | + (57)m       | + (59)m     | ]             |      |
| (65)m= 62.49               | 54.7                     | 56.82        | 50.22       | 48.54     | 42.59       | 40.55                    | 45.45        | 45.96         | 52.56                     | 56.35         | 60.92       |               | (65) |
| in <mark>clude</mark> (57  | 7)m in c <mark>al</mark> | culation of  | of (65)m    | only if c | ylinder is  | s in th <mark>e</mark> o | dwelling     | or hot w      | ate <mark>r is f</mark> r | om com        | munity h    | eating        |      |
| 5. Internal                | gains (see               | e Table 5    | and 5a      | ):        |             |                          |              |               |                           |               |             |               |      |
| Met <mark>abolic</mark> ga |                          | e 5), Wat    | ts          |           |             |                          |              |               |                           |               | i           |               |      |
| Jan                        |                          | Mar          | Apr         | May       | Jun         | Jul                      | Aug          | Sep           | Oct                       | Nov           | Dec         |               |      |
| (66)m= 121.0               |                          | 121.09       | 121.09      | 121.09    | 121.09      | 121.09                   | 121.09       | 121.09        | 121.09                    | 121.09        | 121.09      |               | (66) |
| Lighting gair              |                          | · · · ·      | ·           | · ·       |             | , ·                      |              | 1             | i                         | i             | ·           | I             |      |
| (67)m= 19.95               | 17.72                    | 14.41        | 10.91       | 8.16      | 6.89        | 7.44                     | 9.67         | 12.98         | 16.48                     | 19.24         | 20.51       |               | (67) |
| Appliances g               |                          |              |             | -         |             |                          |              | see Ta        | ble 5                     | 1             |             | I             |      |
|                            | 217.23                   |              |             |           |             |                          |              | 164.23        | 176.2                     | 191.31        | 205.51      |               | (68) |
| Cooking gair               | `                        | · · · · ·    |             | · ·       |             | , <u> </u>               | 1            | e Table       | · · · · ·                 |               | r           | I             |      |
| (69)m= 35.11               |                          | 35.11        | 35.11       | 35.11     | 35.11       | 35.11                    | 35.11        | 35.11         | 35.11                     | 35.11         | 35.11       |               | (69) |
| Pumps and f                | ans gains                | (Table 5     | ōa)         |           |             |                          |              |               |                           |               |             | 1             |      |
| (70)m= 3                   | 3                        | 3            | 3           | 3         | 3           | 3                        | 3            | 3             | 3                         | 3             | 3           |               | (70) |
| Losses e.g.                |                          | on (nega     | tive valu   | es) (Tab  | ole 5)      |                          |              |               |                           |               |             |               |      |
| (71)m= -96.8 <sup>°</sup>  | 7 -96.87                 | -96.87       | -96.87      | -96.87    | -96.87      | -96.87                   | -96.87       | -96.87        | -96.87                    | -96.87        | -96.87      |               | (71) |
| Water heatin               | <u> </u>                 | Table 5)     |             |           |             |                          |              | r             |                           |               |             | I             |      |
| (72)m= 83.99               | 81.39                    | 76.37        | 69.76       | 65.24     | 59.15       | 54.5                     | 61.08        | 63.83         | 70.65                     | 78.27         | 81.88       |               | (72) |
| Total intern               |                          | =            |             |           | (66)        |                          | n + (68)m +  | + (69)m + (   | (70)m + (7                | 1)m + (72)    | m           | 1             |      |
| (73)m= 381.2               |                          | 364.71       | 342.63      | 320.26    | 298.69      | 285.11                   | 291.69       | 303.37        | 325.66                    | 351.14        | 370.22      |               | (73) |
| 6. Solar gai               |                          |              |             | T-bl 0    |             | ·                        |              |               |                           | 1             |             |               |      |
| Solar gains an             |                          | •            |             |           |             |                          | itions to co |               | ie applicat               |               | ion.        | Coinc         |      |
| Orientation:               | Access I<br>Table 6c     |              | Area<br>m²  |           | Flu<br>Tal  | x<br>ble 6a              | Т            | g_<br>able 6b | T                         | FF<br>able 6c |             | Gains<br>(W)  |      |

| _                                      |             |            |            |                  |       |              |                   |          |         |        |          |        |        |      |
|--|-------------|------------|------------|------------------|-------|--------------|-------------------|----------|---------|--------|----------|--------|--------|------|
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | x     | 11.28        | x                 | 0        | .63     | x      | 0.7      | =      | 10.86  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | x     | 22.97        | x                 | 0        | .63     | ×      | 0.7      | =      | 22.11  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | x     | 41.38        | x                 | 0        | .63     | x      | 0.7      | =      | 39.83  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | x     | 67.96        | x                 | 0        | .63     | ×      | 0.7      | =      | 65.42  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | x     | 91.35        | x                 | 0        | .63     | ×      | 0.7      | =      | 87.94  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | x     | 97.38        | ×                 | 0        | .63     | ×      | 0.7      | =      | 93.75  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | ×     | 91.1         | ۲<br>× آ          | 0        | .63     |        | 0.7      | =      | 87.7   | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | ×     | 72.63        | -<br>x            | 0        | .63     |        | 0.7      | =      | 69.92  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | x     | 50.42        | X                 | 0        | .63     | ×      | 0.7      | =      | 48.54  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | ×     | 28.07        | ۲<br>× آ          | 0        | .63     |        | 0.7      | =      | 27.02  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | ×     | 14.2         | ۲<br>× آ          | 0        | .63     |        | 0.7      | =      | 13.67  | (75) |
| Northeast 0.9x                         | 0.77        | x          | 3.1        | 5                | ×     | 9.21         | ے<br>x آ          | 0        | .63     |        | 0.7      | =      | 8.87   | (75) |
| Southwest <sub>0.9x</sub>              | 0.77        | x          | 9.4        | 5                | ×     | 36.79        | Ī                 | 0        | .63     |        | 0.7      | =      | 106.26 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77        | x          | 9.4        | 5                | ×Г    | 62.67        | Ī                 | 0        | .63     |        | 0.7      | =      | 181    | (79) |
| Southwest <sub>0.9x</sub>              | 0.77        | x          | 9.4        | 5                | ×     | 85.75        | Ī                 | 0        | .63     |        | 0.7      | =      | 247.66 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77        | x          | 9.4        | 5                | ×     | 106.25       | Ī                 | 0        | .63     |        | 0.7      | =      | 306.86 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77        | x          | 9.4        | 5                | ×Г    | 119.01       | Ī                 | 0        | .63     |        | 0.7      | =      | 343.71 | (79) |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77        | x          | 9.4        | 5                | ×Г    | 118.15       | 1                 | 0        | .63     | x      | 0.7      | =      | 341.22 | (79) |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77        | ×          | 9.4        | 5                | x     | 113.91       | 1                 | 0        | .63     | x      | 0.7      | -      | 328.97 | (79) |
| Sout <mark>hwest</mark> 0.9x           | 0.77        | ×          | 9.4        | 5                | x     | 104.39       | ī /               | 0        | .63     | x      | 0.7      | =      | 301.48 | (79) |
| Sout <mark>hwest</mark> 0.9x           | 0.77        | ×          | 9.4        | 5                | ×Г    | 92.85        | ī/                | 0        | .63     | ×      | 0.7      | =      | 268.16 | (79) |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77        | ×          | 9.4        | 5                | ×Г    | 69.27        | ī –               | 0        | .63     | ×      | 0.7      | =      | 200.05 | (79) |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77        | ×          | 9.4        | 5                | x     | 44.07        | -                 |          | .63     | ×      | 0.7      | =      | 127.28 | (79) |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77        | ×          | 9.4        | 5                | x     | 31.49        | Ī                 | 0        | .63     | ×      | 0.7      | =      | 90.94  | (79) |
|  |             |            |            |                  |       |              |                   | <u> </u> |         |        |          |        |        |      |
| Solar gains in                         | watts, ca   | lculated   | for each   | n month          |       |              | (83)r             | n = Sum  | (74)m   | (82)m  |          |        |        |      |
| (83)m= 117.12                          | 203.11      | 287.49     | 372.28     | 431.64           | 434   | .97 416.68   | 37                | 1.4 3    | 316.7   | 227.07 | 7 140.94 | 99.81  | ]      | (83) |
| Total gains –                          | internal a  | nd solar   | (84)m =    | : (73)m          | + (83 | s)m, watts   |                   |          |         |        |          |        |        |      |
| (84)m= 498.39                          | 581.78      | 652.2      | 714.91     | 751.9            | 733   | .66 701.79   | 663               | 3.09 6   | 20.07   | 552.73 | 492.09   | 470.03 |        | (84) |
| 7. Mean inte                           | rnal temp   | erature    | (heating   | season           | )     |              |                   |          |         |        |          |        |        |      |
| Temperature                            | during h    | eating p   | eriods ir  | the livi         | ng ar | ea from Ta   | able S            | ), Th1 ( | °C)     |        |          |        | 21     | (85) |
| Utilisation fac                        | ctor for ga | ains for I | iving are  | a, h1,m          | (see  | e Table 9a)  |                   |          |         |        |          |        |        |      |
| Jan                                    | Feb         | Mar        | Apr        | May              | Ju    | ın Jul       | A                 | lug      | Sep     | Oct    | Nov      | Dec    |        |      |
| (86)m= 1                               | 0.99        | 0.97       | 0.89       | 0.72             | 0.5   | 62 0.38      | 0.                | 41       | 0.66    | 0.93   | 0.99     | 1      | 1      | (86) |
| Mean interna                           | al tempera  | ature in   | living are | ea T1 (fo        | Sllow | steps 3 to   | 7 in <sup>-</sup> | Table 9  |         |        |          |        | -      |      |
| (87)m= 20.29                           | 20.45       | 20.65      | 20.86      | 20.97            | 2     |              | -                 |          | 20.99   | 20.84  | 20.53    | 20.27  | ]      | (87) |
| Temperature                            |             | eating n   | ariode in  | rest of          | dwal  | ling from T  | -<br>ahla         | 0 Th2    | (°C)    |        |          |        | 1      |      |
| (88)m= 20.25                           | 20.25       | 20.25      | 20.27      | 20.27            | 20.   |              | -                 |          | 20.27   | 20.27  | 20.26    | 20.26  | ]      | (88) |
|  |             |            |            |                  |       |              |                   |          |         |        |          |        | 1      |      |
| Utilisation factors (89)m= 1           | 0.99        | 0.96       | 0.86       | velling,<br>0.68 | n2,m  | <u> </u>     | т ́               | 35       | 0.59    | 0.9    | 0.99     | 1      | 1      | (89) |
|  | 1 1         |            |            |                  | I     |              | _                 |          |         |        | 0.33     | L      | ]      | (00) |
| Mean interna                           | al tempera  | ature in t | ina rast i | nt dwell         | ina T | 2 (tollow st | anc (             | ≺to 7in  | n Lablı | a Url  |          |        |        |      |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

|  |  |   |  |  |  | i                                    | r              |  |  |  |   |                            |                                    | (00)   |
|--|--|---|--|--|--|--------------------------------------|----------------|--|--|--|---|----------------------------|------------------------------------|--|
| (90)m=   | 19.3   | 19.52   | 19.82  | 20.12  | 20.24  | 20.28                                | 20.28          | 20.28  | 20.27  | 20.09  | 19.65   | 19.27                      |                                    | (90)   |
|  |  |   |  |  |  |                                      |                |  | I  | LA = LIVIN   | g area ÷ (4   | +) =                       | 0.37                               | (91)   |
| Mean   | internal   | temper  | ature (fo  | r the wh   | ole dwe  | lling) = fl                          | LA × T1        | + (1 – fL  | A) × T2  |  |   |                            |                                    |  |
| (92)m=   | 19.66  | 19.86   | 20.12  | 20.39  | 20.51  | 20.54                                | 20.54          | 20.55  | 20.53  | 20.37  | 19.98   | 19.64                      |                                    | (92)   |
| Apply  | adjustr  | nent to t   | he mean  | interna  | temper   | ature fro                            | m Table        | 4e, whe  | ere appro  | opriate  |   |                            |                                    |  |
| (93)m=   | 19.66  | 19.86   | 20.12  | 20.39  | 20.51  | 20.54                                | 20.54          | 20.55  | 20.53  | 20.37  | 19.98   | 19.64                      |                                    | (93)   |
| 8. Sp  | ace heat   | ting requ   | uirement   |  |  |                                      |                |  |  |  |   |                            |                                    |  |
|  | i to the r<br>tilisation   |   |  | •  |  | ed at ste                            | ep 11 of       | Table 9  | o, so tha  | t Ti,m=(   | 76)m an   | d re-calc                  | ulate                              |  |
|  | Jan  | Feb   | Mar  | Apr  | May  | Jun                                  | Jul            | Aug  | Sep  | Oct  | Nov   | Dec                        |                                    |  |
| Utilisa  | ation fac  |   |  |  | may  | Udit                                 | 001            | , lug  | 000  | 000  | 1101  | 200                        |                                    |  |
| (94)m=   | 0.99   | 0.98  | 0.96   | 0.87   | 0.69   | 0.48                                 | 0.34           | 0.37   | 0.62   | 0.9  | 0.99  | 1                          |                                    | (94)   |
|  | ul gains,  | hmGm .  | . W = (94  | 1)m x (84  | 1<br>4)m   |                                      |                | I  |  |  |   |                            |                                    |  |
| (95)m=   | 495.57   | 572.72  | 623.18   | 619.01   | ,<br>521.08  | 355.45                               | 236.63         | 247.89   | 382.7  | 499.57   | 484.77  | 468.14                     |                                    | (95)   |
| Mont   | hly avera  | age exte  | rnal tem   | perature   | e from Ta  | able 8                               | ļ              |  |  |  |   |                            |                                    |  |
| (96)m=   | 4.3  | 4.9   | 6.5  | 8.9  | 11.7   | 14.6                                 | 16.6           | 16.4   | 14.1   | 10.6   | 7.1   | 4.2                        |                                    | (96)   |
| Heat   | loss rate  | for mea   | an intern  | al tempe   | erature,   | Lm , W =                             | -<br>=[(39)m : | r [(93)m   | – (96)m  | ]  |   |                            |                                    |  |
| (97)m=   | 964.07   | 935.39  | 848.39   | 702.96   | 537.2  | 356.62                               | 236.71         | 248.04   | 388.4  | 595.63   | 790.4   | 954.28                     |                                    | (97)   |
| Space  | e heating  | g require   | ement fo   | r each n   | honth, k   | Nh/mon                               | th = 0.02      | 2 <mark>4 x [(9</mark> 7                                   | )m – (95   | )m] x (4 <sup>-</sup>                                      | 1)m   |                            |                                    |  |
| (98)m=   | 348.57   | 243.71  | 167.56   | 60.44  | 12   | 0                                    | 0              | 0  | 0  | 71.47  | 220.06  | 361.69                     |                                    |  |
|  |  |   |  |  |  |                                      |                | Tota   | per year   | (kWh/year  | ) = Sum(9   | 8)15,912 =                 | 1 <mark>4</mark> 85.49             | (98)   |
| Space  | e heating  | g requ <mark>ire</mark>   | ement in   | kWh/m <sup>2</sup>   | vear   |                                      |                |  |  |  |   |                            | 10.07                              | (99)   |
|  |  |   |  |  | , ,  |                                      |                |  |  |  |   |                            | 19.07                              | (33)   |
| 9a. En   | erav rea   | uiremer   |  |  |  | vstems i                             | ncluding       | micro-C  | CHP)   |  |   |                            | 19.07                              |  |
|  | ergy req<br>e heatin   |   |  |  |  | ystems i                             | ncluding       | micro-C  | HP)  | -  |   |                            | 19.07                              |  |
| Sp <mark>ac</mark>   | ergy req<br>e heatin<br>ion of sp  | ig:   | nts – Indi   | vidual h   | eating s   |                                      |                |  | CHP)   | 1  |   |                            | 0                                  | (201)  |
| <b>Spac</b><br>Fracti  | e heatin   | i <b>g:</b><br>ace hea  | nts Indi<br>at from se   | ividual h<br>econdar   | eating sy<br>y/supple  |                                      | system         |  |  |  |   |                            |                                    |  |
| <b>Spac</b><br>Fracti<br>Fracti  | <b>e heatin</b><br>ion of sp   | i <b>g:</b><br>ace hea<br>ace hea   | nts Indi<br>at from so<br>at from m  | vidual h<br>econdar<br>nain syst   | eating s<br>y/supple<br>em(s)  |                                      | system         | (202) = 1 ·  |  | (203)] =   |   |                            | 0                                  | (201)  |
| <b>Spac</b><br>Fracti<br>Fracti<br>Fracti  | <b>e heatin</b><br>ion of sp<br>ion of sp  | i <b>g:</b><br>ace hea<br>ace hea<br>al heatin  | nts Indi<br>at from so<br>at from m<br>ng from n   | ividual h<br>econdar<br>nain syst<br>main sys  | eating sy<br>y/supple<br>em(s)<br>stem 1   |                                      | system         | (202) = 1 ·  | - (201) =  | (203)] =   |   |                            | 0                                  | (201)  |
| <b>Spac</b><br>Fracti<br>Fracti<br>Fracti<br>Efficie   | e heatin<br>ion of sp<br>ion of sp<br>ion of tot   | n <b>g:</b><br>ace hea<br>ace hea<br>cal heatin<br>nain spa   | nts – Indi<br>at from so<br>at from m<br>ng from n<br>ace heat   | vidual h<br>econdary<br>nain syst<br>main syste  | eating sy<br>y/supple<br>em(s)<br>stem 1<br>em 1   | mentary                              | system         | (202) = 1 ·  | - (201) =  | (203)] =   |   |                            | 0                                  | (201)<br>(202)<br>(204)                                  |
| <b>Spac</b><br>Fracti<br>Fracti<br>Fracti<br>Efficie   | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s  | ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda  | nts Indi<br>at from so<br>at from m<br>ng from n<br>ace heati<br>ry/supple   | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar   | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating   | mentary<br>g system                  | system         | (202) = 1 ·<br>(204) = (2                                  | - (201) =<br>02) × [1 -  |  | Nov   | [                          | 0<br>1<br>1<br>93.4<br>0           | (201)<br>(202)<br>(204)<br>(206)<br>(208)                |
| <b>Spac</b><br>Fracti<br>Fracti<br>Efficie<br>Efficie  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s  | ng:<br>ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda<br>Feb  | nts – Indi<br>at from so<br>at from m<br>ng from n<br>ace heati<br>ry/supple<br>Mar  | vidual h<br>econdar<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr   | eating sy<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>May   | mentary<br>g system<br>Jun           | system         | (202) = 1 ·  | - (201) =  | (203)] =<br>Oct  | Nov   | Dec                        | 0<br>1<br>1<br>93.4                | (201)<br>(202)<br>(204)<br>(206)<br>(208)                |
| <b>Spac</b><br>Fracti<br>Fracti<br>Efficie<br>Efficie  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s  | ng:<br>ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda<br>Feb  | nts – Indi<br>at from so<br>at from m<br>ng from n<br>ace heati<br>ry/supple<br>Mar  | vidual h<br>econdar<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr   | eating sy<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>May   | mentary<br>g system<br>Jun           | system         | (202) = 1 ·<br>(204) = (2                                  | - (201) =<br>02) × [1 -  |  | Nov<br>220.06   | Dec<br>361.69              | 0<br>1<br>1<br>93.4<br>0           | (201)<br>(202)<br>(204)<br>(206)<br>(208)                |
| <b>Spac</b><br>Fracti<br>Fracti<br>Efficie<br>Space  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57  | eg:<br>ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda<br>Feb<br>g require<br>243.71   | nts Indi<br>at from so<br>at from m<br>ng from n<br>ace heati<br>ry/supple<br>Mar<br>ement (c<br>167.56  | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44   | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above                                     | mentary<br>g system<br>Jun           | system         | (202) = 1 ·<br>(204) = (2<br>Aug                           | - (201) =<br>02) × [1 -<br>Sep                                     | Oct  |   |                            | 0<br>1<br>1<br>93.4<br>0           | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar          |
| <b>Spac</b><br>Fracti<br>Fracti<br>Efficie<br>Space  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>348.57<br>$n = \{[(98)]$   | ng:<br>ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda<br>Feb<br>g require<br>243.71   | nts Indi<br>at from so<br>at from m<br>ng from m<br>ace heati<br>ry/supple<br>Mar<br>Mar<br>ement (c<br>167.56   | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44<br>00 ÷ (20                                 | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above<br>12                               | mentary<br>g system<br>Jun<br>)<br>0 | system         | (202) = 1 ·<br>(204) = (2<br>Aug                           | - (201) =<br>02) × [1 -<br>Sep<br>0                                | Oct<br>71.47   | 220.06  |                            | 0<br>1<br>1<br>93.4<br>0           | (201)<br>(202)<br>(204)<br>(206)<br>(208)                |
| <b>Spac</b><br>Fracti<br>Fracti<br>Efficie<br>Space  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57  | eg:<br>ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda<br>Feb<br>g require<br>243.71   | nts Indi<br>at from so<br>at from m<br>ng from n<br>ace heati<br>ry/supple<br>Mar<br>ement (c<br>167.56  | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44   | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above                                     | mentary<br>g system<br>Jun           | system         | $(202) = 1 \cdot (204) = (2)$<br>Aug                       | - (201) =<br>02) × [1 -<br><u>Sep</u><br>0                         | Oct<br>71.47<br>76.52                                      | 220.06<br>235.61  | 361.69<br>387.25           | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar          |
| <b>Spac</b><br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2   | ng:<br>ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda<br>Feb<br>g require<br>243.71<br>m x (20<br>260.93  | nts – Indi<br>at from s<br>at from m<br>ng from n<br>ace heati<br>ry/supple<br>Mar<br>ement (c<br>167.56<br>(4)] } x 1<br>179.4  | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44<br>00 ÷ (20<br>64.71                        | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>d above<br>12<br>06)<br>12.84                      | mentary<br>g system<br>Jun<br>)<br>0 | system         | $(202) = 1 \cdot (204) = (2)$<br>Aug                       | - (201) =<br>02) × [1 -<br>Sep<br>0                                | Oct<br>71.47<br>76.52                                      | 220.06<br>235.61  | 361.69<br>387.25           | 0<br>1<br>1<br>93.4<br>0           | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar          |
| Space<br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2<br>e heating  | ng:<br>ace hea<br>ace hea<br>cal heatin<br>nain spa<br>seconda<br>Feb<br>g require<br>243.71<br>m x (20<br>260.93   | nts Indi<br>at from s<br>at from m<br>ng from m<br>ace heati<br>ry/supple<br>Mar<br>ement (c<br>167.56<br>(4)] } x 1<br>179.4  | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44<br>00 ÷ (20<br>64.71                        | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>d above<br>12<br>06)<br>12.84                      | mentary<br>g system<br>Jun<br>)<br>0 | system         | $(202) = 1 \cdot (204) = (2)$<br>Aug                       | - (201) =<br>02) × [1 -<br><u>Sep</u><br>0                         | Oct<br>71.47<br>76.52                                      | 220.06<br>235.61  | 361.69<br>387.25           | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar          |
| Space<br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m<br>Space<br>= {[(98                              | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2<br>e heating<br>)m x (20)                                     | ng:<br>ace hea<br>ace hea<br>cal heatin<br>nain spa<br>seconda<br>Feb<br>g require<br>243.71<br>m x (20<br>260.93   | nts Indi<br>at from s<br>at from m<br>ng from m<br>ace heati<br>ry/supple<br>Mar<br>ement (c<br>167.56<br>(4)] } x 1<br>179.4  | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44<br>00 ÷ (20<br>64.71                        | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>d above<br>12<br>06)<br>12.84                      | mentary<br>g system<br>Jun<br>)<br>0 | system         | $(202) = 1 \cdot (204) = (2)$<br>Aug                       | - (201) =<br>02) × [1 -<br><u>Sep</u><br>0                         | Oct<br>71.47<br>76.52                                      | 220.06<br>235.61  | 361.69<br>387.25           | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar          |
| Space<br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m  | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2<br>e heating<br>)m x (20)                                     | ace hea<br>ace hea<br>al heatin<br>nain spa<br>seconda<br>Feb<br>g require<br>243.71<br>m x (20<br>260.93<br>g fuel (s<br>1)] } x 1   | hts Indi<br>at from so<br>at from m<br>ng from m<br>ace heati<br>ry/supple<br>Mar<br>Mar<br>$ment (c167.56(4)] } x 1179.4econdar00 ÷ (20)$   | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>60.44<br>00 ÷ (20<br>64.71<br>y), kWh/<br>8)     | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>d above<br>12<br>06)<br>12.84<br>month             | g system                             | system         | (202) = 1 + (204) = (2)<br>Aug<br>0<br>Tota                | - (201) =<br>02) × [1 -<br>0<br>0<br>1 (kWh/yea                    | Oct<br>71.47<br>76.52<br>ar) =Sum(2                        | 220.06<br>235.61<br>211) <sub>15,1012</sub><br>0                            | 361.69<br>387.25<br>=<br>0 | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar<br>(211) |
| Spac<br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m<br>Space<br>= {[(98<br>(215)m=                    | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2<br>e heating<br>)m x (20                                      | $\begin{array}{c} \mathbf{g:} \\ \mathbf{ace hea} \\ a$ | hts Indi<br>at from so<br>at from m<br>ng from m<br>ace heati<br>ry/supple<br>Mar<br>Mar<br>$ment (c167.56(4)] } x 1179.4econdar00 ÷ (20)$   | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculated<br>60.44<br>00 ÷ (20<br>64.71<br>y), kWh/<br>8)     | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>d above<br>12<br>06)<br>12.84<br>month             | g system                             | system         | (202) = 1 + (204) = (2)<br>Aug<br>0<br>Tota                | - (201) =<br>02) × [1 -<br>Sep<br>0<br>1 (kWh/yea                  | Oct<br>71.47<br>76.52<br>ar) =Sum(2                        | 220.06<br>235.61<br>211) <sub>15,1012</sub><br>0                            | 361.69<br>387.25<br>=<br>0 | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar          |
| Spac<br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m<br>Space<br>= {[(98<br>(215)m=                    | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2<br>e heating<br>)m x (20<br>n = 100<br>m x (20)               | $\begin{array}{c} \mathbf{g:} \\ \mathbf{ace hea} \\ a$ | hts Indi<br>at from so<br>at from m<br>ace heati<br>ry/supple<br>Mar<br>$ment (c167.56(4)] } x 1(179.4)econdary00 \div (20)$   | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44<br>00 ÷ (20<br>64.71<br>y), kWh/<br>8)<br>0 | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above<br>12<br>06)<br>12.84<br>month<br>0 | g system                             | system         | (202) = 1 + (204) = (2)<br>Aug<br>0<br>Tota                | - (201) =<br>02) × [1 -<br>0<br>0<br>1 (kWh/yea                    | Oct<br>71.47<br>76.52<br>ar) =Sum(2                        | 220.06<br>235.61<br>211) <sub>15,1012</sub><br>0                            | 361.69<br>387.25<br>=<br>0 | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar<br>(211) |
| Spac<br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m<br>Space<br>= {[(98<br>(215)m=                    | e heatin<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2<br>e heating<br>)m x (20                                      | $\begin{array}{c} \mathbf{g:} \\ \mathbf{ace hea} \\ a$ | hts Indi<br>at from so<br>at from m<br>ace heati<br>ry/supple<br>Mar<br>$ment (c167.56(4)] } x 1(179.4)econdary00 \div (20)$   | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44<br>00 ÷ (20<br>64.71<br>y), kWh/<br>8)<br>0 | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>May<br>d above<br>12<br>06)<br>12.84<br>month<br>0 | g system                             | system         | (202) = 1 + (204) = (2)<br>Aug<br>0<br>Tota                | - (201) =<br>02) × [1 -<br>0<br>0<br>1 (kWh/yea                    | Oct<br>71.47<br>76.52<br>ar) =Sum(2                        | 220.06<br>235.61<br>211) <sub>15,1012</sub><br>0                            | 361.69<br>387.25<br>=<br>0 | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar<br>(211) |
| Spac<br>Fracti<br>Fracti<br>Efficie<br>Space<br>(211)m<br>Space<br>= {[(98<br>(215)m=<br>Water<br>Output | e heating<br>ion of sp<br>ion of tot<br>ency of r<br>ency of s<br>Jan<br>e heating<br>348.57<br>n = {[(98)<br>373.2<br>e heating<br>)m x (20<br>)m x (20<br>heating<br>t from wa | ace heat<br>ace heat<br>ace heat<br>al heat<br>anain spat<br>seconda<br>Feb<br>243.71<br>m x (20)<br>260.93<br>$g fuel (so1)] \} x 10ater heat175.6$  | hts Indi<br>at from s<br>at from m<br>ng from m<br>ace heati<br>ry/supple<br>Mar<br>ment (c167.56)<br>(179.4)<br>(179.4)<br>(179.4)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20)<br>(20 | vidual h<br>econdary<br>nain syst<br>main syst<br>ing syste<br>ementar<br>Apr<br>alculate<br>60.44<br>00 ÷ (20<br>64.71<br>y), kWh/<br>8)<br>0 | eating s<br>y/supple<br>em(s)<br>stem 1<br>em 1<br>y heating<br>d above<br>12<br>06)<br>12.84<br>month<br>0        | mentary<br>g system<br>Jun<br>)<br>0 | system         | (202) = 1 ·<br>(204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota | - (201) =<br>02) × [1 -<br>0<br>0<br>I (kWh/yea<br>0<br>I (kWh/yea | Oct<br>71.47<br>76.52<br>ar) = Sum(2)<br>0<br>ar) = Sum(2) | 220.06<br>235.61<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub> | 361.69<br>387.25<br>=<br>0 | 0<br>1<br>1<br>93.4<br>0<br>kWh/ye | (201)<br>(202)<br>(204)<br>(206)<br>(208)<br>ar<br>(211) |

| (217)m= 86.43 85.88 84.83 82.81 80.94   | 80.3 80.3                             | 80.3         | 80.3       | 83.05                 | 85.54   | 86.57      |                           | (217)                   |
|---|---------------------------------------|--------------|------------|-----------------------|---------|------------|---------------------------|-------------------------|
| Fuel for water heating, kWh/month   |                                       |              |            |                       |         |            |                           |                         |
| $(219)m = (64)m \times 100 \div (217)m$<br>$(219)m = 232.07  204.48  215.37  195.68  193.83  1^{\circ}$ | 72.08 164.87                          | 183.79       | 185.82     | 204.59                | 212.04  | 226.23     |                           |                         |
|   |                                       | Total        | l = Sum(2  | 19a) <sub>112</sub> = |         | I          | 2390.85                   | (219)                   |
| Annual totals   |                                       |              |            | k١                    | Nh/year | . l        | kWh/year                  |                         |
| Space heating fuel used, main system 1  |                                       |              |            |                       |         |            | 1590.46                   | ]                       |
| Water heating fuel used   |                                       |              |            |                       |         | [          | 2390.85                   | Ī                       |
| Electricity for pumps, fans and electric keep-hot   |                                       |              |            |                       |         | L          |                           |                         |
|   |                                       |              |            |                       |         |            |                           | (000-)                  |
| central heating pump:   |                                       |              |            |                       |         | 30         |                           | (230c)                  |
| boiler with a fan-assisted flue   |                                       |              |            |                       |         | 45         |                           | (230e)                  |
| Total electricity for the above, kWh/year   |                                       | sum          | of (230a). | (230g) =              |         |            | 75                        | (231)                   |
| Electricity for lighting  |                                       |              |            |                       |         |            | 352.4                     | (232)                   |
| 12a. CO2 emissions – Individual heating system  | s including mi                        | cro-CHP      | )          |                       |         |            |                           |                         |
|   | Energy                                |              |            | Fmiss                 | ion fac | tor        | Emissions                 |                         |
|   | kWh/year                              |              |            | kg CO2                |         |            | kg CO2/yea                | ar                      |
| Space heating (main system 1)   | (211) x                               |              |            | 0.21                  | 16      | =          | 343.54                    | (261)                   |
|   | (015)                                 |              |            | 0.5                   |         |            | 0                         | (263)                   |
| Space heating (secondary)   | (215) x                               |              |            | 0.5                   | 9       | =          | 0                         | (====)                  |
| Water heating   | (215) x<br>(219) x                    |              |            | 0.2                   |         | = [        | 516.42                    | ](264)                  |
| Water heating   |                                       | + (263) + (2 | 264) =     |                       |         | l          | 516.42                    | (264)                   |
| Water heating<br>Space and water heating  | (219) x<br>(261) + (262) ·            | + (263) + (: | 264) =     | 0.21                  | 16      | = [<br>[   | 516.42<br>859.96          | (264)<br>(265)          |
| Water heating<br>Space and water heating<br>Electricity for pumps, fans and electric keep-hot           | (219) x<br>(261) + (262) ·<br>(231) x | + (263) + (: | 264) =     | 0.2                   | 9       | = [<br>= [ | 516.42<br>859.96<br>38.93 | (264)<br>(265)<br>(267) |
| Water heating<br>Space and water heating  | (219) x<br>(261) + (262) ·            | + (263) + (: |            | 0.2                   | 9       | = [<br>[   | 516.42<br>859.96          | (264)<br>(265)          |
| Water heating<br>Space and water heating<br>Electricity for pumps, fans and electric keep-hot           | (219) x<br>(261) + (262) ·<br>(231) x | + (263) + (2 |            | 0.2                   | 9       | = [<br>= [ | 516.42<br>859.96<br>38.93 | (264)<br>(265)<br>(267) |

TER =

13.89 (273)

|   |  |                                | User D                | etails:              |                |                  |                       |                           |                          |                     |
|---|--|--------------------------------|-----------------------|----------------------|----------------|------------------|-----------------------|---------------------------|--------------------------|---------------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 20   |                                |                       | Stroma<br>Softwa     | re Ver         |                  |                       | Versio                    | n: 1.0.4.23              |                     |
| Address :   | 1 Bed Flat, 219-22   |                                |                       | Address:             |                | ah lunct         | tion I ON             |                           |                          |                     |
| 1. Overall dwelling dime  |  | 5 Columan                      |                       | ne, Loug             | μηροιοαί       | gri Junci        |                       |                           |                          |                     |
| Ground floor  |  |                                |                       | <b>a(m²)</b><br>19.8 | (1a) x         |                  | <b>ight(m)</b><br>2.5 | (2a) =                    | <b>Volume(m</b><br>124.5 | <b>3)</b><br>(3a)   |
| Total floor area TFA = (1a  | a)+(1b)+(1c)+(1d)+(1   | e)+(1n)                        | ) 4                   | 19.8                 | (4)            |                  |                       |                           |                          |                     |
| Dwelling volume   |  |                                |                       |                      | (3a)+(3b)      | )+(3c)+(3c       | l)+(3e)+              | .(3n) =                   | 124.5                    | (5)                 |
| 2. Ventilation rate:  |  |                                |                       |                      |                |                  |                       |                           |                          |                     |
| Number of chimneys<br>Number of open flues  | main s<br>heating<br>0 + [<br>0 + [  | secondary<br>heating<br>0<br>0 | /<br>] + [_<br>] + [_ | 0<br>0               | ] = [<br>] = [ | <b>total</b> 0 0 |                       | 40 =<br>20 =              | 0<br>0                   | ur<br>(6a)<br>(6b)  |
| Number of intermittent fa   |  | •                              |                       | 0                    |                | -                | ,                     | 10 =                      | -                        |                     |
|   | -  |                                |                       |                      | Ļ              | 2                |                       | l                         | 20                       | (7a)                |
| Number of passive vents   |  |                                |                       |                      | L              | 0                |                       | 0 =                       | 0                        | (7b)                |
| Number of flueless gas fi   |  |                                |                       |                      | L              | 0                | X 4                   | <sup>40</sup> =<br>Air ch | 0<br>anges per he        | (7c)                |
| Infiltration due to chimne  |  |                                |                       |                      |                | 20               |                       | ÷ (5) =                   | 0.16                     | (8)                 |
| If a pressurisation test has b<br>Number of storeys in th<br>Additional infiltration<br>Structural infiltration: 0.<br>if both types of wall are pri<br>deducting areas of openir | ne dwelling (ns)<br>.25 for steel or timber<br>resent, use the value corre | r frame or                     | 0.35 for              | masonr               | y constr       |                  |                       | -1]x0.1 =                 | 0<br>0<br>0              | (9)<br>(10)<br>(11) |
| If suspended wooden f   | • / /  | aled) or 0.4                   | 1 (seale              | d), else             | enter 0        |                  |                       |                           | 0                        | (12)                |
| If no draught lobby, en   |  | ,                              | ,                     | ,.                   |                |                  |                       |                           | 0                        | (13)                |
| Percentage of windows   | s and doors draught  | stripped                       |                       |                      |                |                  |                       |                           | 0                        | (14)                |
| Window infiltration   |  |                                |                       | 0.25 - [0.2          | x (14) ÷ 1     | = [00            |                       | İ                         | 0                        | (15)                |
| Infiltration rate   |  |                                |                       | (8) + (10) ·         | + (11) + (1    | 2) + (13) -      | + (15) =              |                           | 0                        | (16)                |
| Air permeability value,   | • •  |                                | •                     |                      | •              | etre of e        | envelope              | area                      | 5                        | (17)                |
| If based on air permeabil   |  |                                |                       |                      |                |                  |                       |                           | 0.41                     | (18)                |
| Air permeability value applie<br>Number of sides sheltere   |  | as been done                   | e or a deg            | ree air pei          | meability      | is being u       | sed                   | I                         |                          | (19)                |
| Shelter factor  | u  |                                |                       | (20) = 1 - [         | 0.075 x (1     | 9)] =            |                       |                           | 3<br>0.78                | (19)                |
| Infiltration rate incorporat  | ing shelter factor   |                                |                       | (21) = (18)          | x (20) =       |                  |                       | l                         | 0.32                     | (21)                |
| Infiltration rate modified for  | -  | ed                             |                       |                      |                |                  |                       | I                         | 0.02                     |                     |
| Jan Feb   | Mar Apr May  |                                | Jul                   | Aug                  | Sep            | Oct              | Nov                   | Dec                       |                          |                     |
| Monthly average wind sp   | eed from Table 7   |                                |                       |                      |                |                  |                       |                           |                          |                     |
| (22)m= 5.1 5  | 4.9 4.4 4.3  | 3.8                            | 3.8                   | 3.7                  | 4              | 4.3              | 4.5                   | 4.7                       |                          |                     |
| Wind Factor (22a)m = (22  | 2)m ÷ 4  |                                |                       |                      |                |                  |                       |                           |                          |                     |
|   | 1.23         1.1         1.08  | 0.95                           | 0.95                  | 0.92                 | 1              | 1.08             | 1.12                  | 1.18                      |                          |                     |
|   |  |                                |                       |                      |                |                  |                       |                           |                          |                     |

| Adjust                           | ed infiltra                  | ation rat  | e (allowi  | ng for sh                               | elter an    | d wind s    | peed) =     | (21a) x      | (22a)m                                | -                  | -                |                      |               |                         |
|----------------------------------|------------------------------|------------|------------|---|-------------|-------------|-------------|--------------|---------------------------------------|--------------------|------------------|----------------------|---------------|-------------------------|
| ~ ' '                            | 0.41                         | 0.4        | 0.39       | 0.35                                    | 0.34        | 0.3         | 0.3         | 0.29         | 0.32                                  | 0.34               | 0.36             | 0.37                 |               |                         |
|                                  | <i>ate effec</i><br>echanica |            | -          | rate for t                              | he appli    | cable ca    | se          |              |                                       |                    |                  |                      |               | (23a)                   |
|                                  | aust air he                  |            |            | endix N, (2                             | 3b) = (23a  | a) × Fmv (e | equation (I | N5)) , othei | wise (23b                             | ) = (23a)          |                  |                      | 0             | (23a)<br>(23b)          |
|                                  | anced with                   | • •        | 0 11       |   | , (         | , (         | • •         | ,, .         | ,                                     | , , ,              |                  |                      | 0             | (23c)                   |
| a) If                            | balance                      | d mecha    | anical ve  | entilation                              | with he     | at recove   | erv (MVI    | HR) (24a     | m = (22)                              | 2b)m + (           | 23b) × [′        | 1 – (23c)            | -             | ()                      |
| (24a)m=                          | r                            | 0          | 0          | 0                                       | 0           | 0           | 0           | 0            | 0                                     | 0                  | 0                | 0                    | ]             | (24a)                   |
| b) If                            | balance                      | d mecha    | anical ve  | entilation                              | without     | heat rec    | overy (N    | и<br>V) (24b | )m = (22                              | 2b)m + (2          | 23b)             | <u> </u>             | 1             |                         |
| ,<br>(24b)m=                     | 0                            | 0          | 0          | 0                                       | 0           | 0           | 0           | 0            | 0                                     | 0                  | 0                | 0                    |               | (24b)                   |
| c) If                            | whole ho                     | ouse ex    | tract ver  | ntilation of                            | or positiv  | ve input v  | ventilatio  | on from c    | outside                               | !                  | !                |                      | 1             |                         |
| ,                                | if (22b)m                    |            |            |   | •           | •           |             |              |                                       | 5 × (23b           | )                |                      |               |                         |
| (24c)m=                          | 0                            | 0          | 0          | 0                                       | 0           | 0           | 0           | 0            | 0                                     | 0                  | 0                | 0                    |               | (24c)                   |
| ,                                | natural v<br>if (22b)m       |            |            |   |             |             |             |              |                                       | 0.5]               |                  |                      | -             |                         |
| (24d)m=                          | 0.58                         | 0.58       | 0.58       | 0.56                                    | 0.56        | 0.55        | 0.55        | 0.54         | 0.55                                  | 0.56               | 0.56             | 0.57                 |               | (24d)                   |
| Effe                             | ctive air                    | change     | rate - er  | nter (24a                               | ) or (24t   | o) or (24   | c) or (24   | d) in boy    | (25)                                  |                    |                  |                      |               |                         |
| (25)m=                           | 0.58                         | 0.58       | 0.58       | 0.56                                    | 0.56        | 0.55        | 0.55        | 0.54         | 0.55                                  | 0 <mark>.56</mark> | 0.56             | 0.57                 |               | (25)                    |
| 3 He                             | at losses                    | and he     | at loss i  | naramete                                | ər:         |             |             |              |                                       |                    |                  |                      |               |                         |
| ELEN                             |                              | Gros       |            | Openin                                  |             | Net Ar      | ea          | U-valı       | le                                    | AXU                |                  | k-value              |               | AXk                     |
|                                  |                              | area       |            | m                                       |             | A ,r        |             | W/m2         |                                       | (W/I               | K)               | kJ/m <sup>2</sup> ·l |               | kJ/K                    |
| Windo                            | ws Type                      | 1          |            |   |             | 10.13       | x1          | /[1/( 1.4 )+ | 0.04] =                               | 13.43              |                  |                      |               | (27)                    |
| Windo                            | ws Type                      | 2          |            |   |             | 2.32        | x1          | /[1/( 1.4 )+ | 0.04] =                               | 3.08               |                  |                      |               | (27)                    |
| Wall <mark>s</mark> <sup>-</sup> | Type1                        | 19.        | 5          | 10.13                                   | 3           | 9.37        | x           | 0.18         | ] = [                                 | 1.69               |                  |                      |               | (29)                    |
| Walls <sup>-</sup>               | Type2                        | 3.5        |            | 2.32                                    |             | 1.18        | x           | 0.18         | = [                                   | 0.21               | ٦ ī              |                      | ┓ ┏           | (29)                    |
| Total a                          | rea of el                    | ements     | , m²       |   |             | 23          |             |              |                                       |                    |                  |                      |               | (31)                    |
| Party v                          | vall                         |            |            |   |             | 51.75       | 5 x         | 0            | =                                     | 0                  |                  |                      |               | (32)                    |
| Party f                          | loor                         |            |            |   |             | 49.8        |             |              | '                                     |                    | L                |                      | $\dashv$      | (32a)                   |
| Party of                         | ceiling                      |            |            |   |             | 49.8        |             |              |                                       |                    | Γ                |                      | $\exists$     | (32b)                   |
| Interna                          | al wall **                   |            |            |   |             | 45.6        |             |              |                                       |                    | Г                |                      | $\dashv$      | (32c)                   |
|                                  | dows and                     |            |            |   |             |             | ated using  | formula 1    | /[(1/U-valu                           | ie)+0.04] a        | L<br>as given in | paragraph            |               |                         |
|                                  | le the area<br>heat los      |            |            |   | s and par   | titions     |             | (26)(30)     | + (32) -                              |                    |                  |                      |               |                         |
|                                  | apacity (                    |            |            | 0)                                      |             |             |             | (20)(00)     |                                       | (30) + (32         | 2) + (225)       | (220) -              | 18.4          | (33)                    |
|                                  | apacity (<br>al mass         |            |            | 2 – Cm ·                                | TEA) ir     | k l/m2k     |             |              |                                       | tive Value         | · · · ·          | (320) =              | 13281.        |                         |
|                                  | ign assessi                  |            | •          |   |             |             |             | ecisely the  |                                       |                    |                  | ahle 1f              | 250           | (35)                    |
|                                  | used instea                  |            |            |   | conotract   |             | naionii pi  |              | maloutro                              | valuee of          |                  |                      |               |                         |
| Therm                            | al bridge                    | es : S (L  | x Y) cal   | culated u                               | using Ap    | pendix ł    | <           |              |                                       |                    |                  |                      | 2.25          | (36)                    |
|                                  | of therma                    |            | are not kn | own (36) =                              | = 0.05 x (3 | 1)          |             |              | ()                                    | ()                 |                  |                      | (             |                         |
|                                  | abric hea                    |            |            |   |             |             |             |              |                                       | (36) =             |                  |                      | 20.65         | (37)                    |
| Ventila                          | tion hea                     |            |            |   |             |             |             |              |                                       | = 0.33 × (         |                  | r                    | 1             |                         |
| (00)                             | Jan                          | Feb        | Mar        | Apr                                     | May         | Jun         | Jul         | Aug          | Sep                                   | Oct                | Nov              | Dec                  |               | (00)                    |
| (38)m=                           | 23.92                        | 23.79      | 23.66      | 23.06                                   | 22.95       | 22.42       | 22.42       | 22.32        | 22.62                                 | 22.95              | 23.18            | 23.42                | l             | (38)                    |
|                                  | ansfer c                     |            |            | , |             |             |             | 1            | · · · · · · · · · · · · · · · · · · · | = (37) + (3        |                  | 1                    | 1             |                         |
| (39)m=                           | 44.58                        | 44.44      | 44.32      | 43.71                                   | 43.6        | 43.07       | 43.07       | 42.97        | 43.27                                 | 43.6               | 43.83            | 44.07                | (             |                         |
| Stroma I                         | FSAP 2012                    | 2 Version: | 1.0.4.23   | (SAP 9.92)                              | - http://ww | ww.stroma   | .com        |              | ,                                     | Average =          | Sum(39)1         | 12 /12=              | 43.7 <b>þ</b> | age 2 o <sup>(39)</sup> |

| Heat lo      | oss para            | ımeter (H    | HLP), W            | /m²K                 |             |            |             |                        | (40)m                  | = (39)m ÷   | · (4)   |          |            |              |
|--------------|---------------------|--------------|--------------------|----------------------|-------------|------------|-------------|------------------------|------------------------|-------------|---|----------|------------|--------------|
| (40)m=       | 0.9                 | 0.89         | 0.89               | 0.88                 | 0.88        | 0.86       | 0.86        | 0.86                   | 0.87                   | 0.88        | 0.88  | 0.88     |            |              |
| Numb         | ar of day           | re in mo     | nth (Tab           | lo 12)               |             |            |             |                        |                        | Average =   | Sum(40)1.   | .12 /12= | 0.88       | (40)         |
| Numbe        | Jan                 | Feb          | Mar                | Apr                  | May         | Jun        | Jul         | Aug                    | Sep                    | Oct         | Nov   | Dec      |            |              |
| (41)m=       | 31                  | 28           | 31                 | 30                   | 31          | 30         | 31          | 31                     | 30                     | 31          | 30  | 31       |            | (41)         |
|              |                     |              |                    |                      |             |            |             | I                      |                        |             |   |          | l          |              |
| 4. Wa        | ater heat           | ting ene     | rgy requ           | irement:             |             |            |             |                        |                        |             |   | kWh/ye   | ear:       |              |
| if TF        |                     |              |                    | (1 - exp             | o(-0.0003   | 849 x (TF  | FA -13.9    | )2)] + 0.(             | 0013 x ( <sup>-</sup>  | TFA -13     |   | 68       | ]          | (42)         |
| Reduce       | the annua           | al average   | hot water          | usage by             |             | welling is | designed    | (25 x N)<br>to achieve |                        | se target o |   | 1.2      | ]          | (43)         |
|              | Jan                 | Feb          | Mar                | Apr                  | May         | Jun        | Jul         | Aug                    | Sep                    | Oct         | Nov   | Dec      |            |              |
| Hot wate     | er usage i          | n litres pei | r day for e        | ach month            | Vd,m = fa   | ctor from  | Table 1c x  | (43)                   |                        |             |   |          |            |              |
| (44)m=       | 81.62               | 78.65        | 75.68              | 72.72                | 69.75       | 66.78      | 66.78       | 69.75                  | 72.72                  | 75.68       | 78.65   | 81.62    |            | _            |
| <b>Enorm</b> | content of          | botwatow     | used so            | laulatad m           | anthly 1    | 100 v Vd - | ~ ~ ~ ~ ~ / | Tm / 2600              |                        |             | <mark>m(44)<sub>112</sub> =</mark><br>ables 1b, 1 |          | 890.4      | (44)         |
|              |                     |              |                    |                      |             |            |             |                        |                        |             |   |          |            |              |
| (45)m=       | 121.04              | 105.86       | 109.24             | 95.24                | 91.38       | 78.86      | 73.07       | 83.85                  | 84.85                  | 98.89       | 107.94  | 117.22   | 1407.40    | (45)         |
| lf instan    | taneous w           | ater heati   | ng at poin         | t of use (no         | o hot water | storage),  | enter 0 in  | boxes (46              |                        | l otal = Su | m(45) <sub>112</sub> =                            |          | 1167.46    | (45)         |
| (46)m=       | 18.16               | 15.88        | 16.39              | 14.29                | 13.71       | 11.83      | 10.96       | 12.58                  | 12.73                  | 14.83       | 16.19   | 17.58    |            | (46)         |
| Water        | storage             | loss:        | -                  |                      |             |            |             |                        |                        |             |   |          |            |              |
| Storag       | e volum             | e (litres)   | ) includir         | ng any se            | olar or N   | /WHRS      | storage     | within sa              | a <mark>me ve</mark> s | sel         |   | 0        |            | (47)         |
|              | -                   | -            |                    |                      | velling, e  |            |             |                        | ·                      |             |   |          |            |              |
|              |                     |              | hot wate           | er (this ir          | ncludes i   | nstantar   | neous co    | ombi boil              | ers) ente              | er '0' in ( | 47)   |          |            |              |
|              | storage<br>nanufact |              | eclared            | oss fact             | or is kno   | wn (kWł    | n/dav):     |                        |                        |             |   | )        |            | (48)         |
|              |                     |              | m Table            |                      |             | (          | .,          |                        |                        |             |   | )<br>)   |            | (49)         |
| •            |                     |              |                    | , kWh/y              | ear         |            |             | (48) x (49)            | ) =                    |             |   | )<br>)   |            | (50)         |
|              |                     |              | -                  | •                    | loss fact   | or is not  | known:      | (,,                    | /                      |             | L`  | 5        |            | (00)         |
|              |                     | •            |                    |                      | le 2 (kW    | h/litre/da | ay)         |                        |                        |             | (   | )        |            | (51)         |
|              | -                   | -            | see secti          | on 4.3               |             |            |             |                        |                        |             |   |          | 1          |              |
|              |                     | from Ta      | bie ∠a<br>om Table | 2h                   |             |            |             |                        |                        |             |   | )        |            | (52)<br>(53) |
|              |                     |              |                    |                      | oor         |            |             | (47) x (51)            | ) v (52) v (           | 52) -       |   | 0        |            |              |
|              |                     | (54) in (5   | -                  | e, kWh/y             | eal         |            |             | (47) X (31)            | )                      | 55) =       |   | )<br>)   |            | (54)<br>(55) |
|              | . ,                 | . , .        |                    | for each             | month       |            |             | ((56)m = (             | 55) × (41)             | m           | `   | 5        |            | (00)         |
| (56)m=       | 0                   | 0            | 0                  | 0                    | 0           | 0          | 0           |                        | 0                      | 0           | 0   | 0        | 1          | (56)         |
|              | -                   | ÷            | •                  | -                    | -           |            |             | -                      | •                      | -           | H11) is fro                                       | -        | l<br>lix H | (00)         |
| (57)m=       | 0                   | 0            | 0                  | 0                    | 0           | 0          | 0           | 0                      | 0                      | 0           | 0   | 0        |            | (57)         |
|              |                     |              | I<br>Doulol) fr    | ı<br>əm Tablı        |             |            | I           | 1                      | I                      |             |   | )        | 1          | (58)         |
|              |                     |              |                    | om Table<br>for each |             | 59)m = (   | (58) ÷ 36   | 65 × (41)              | m                      |             |   | 5        | I          | (30)         |
|              |                     |              |                    |                      |             |            | . ,         | ng and a               |                        | r thermo    | stat)   |          |            |              |
| (59)m=       | 0                   | 0            | 0                  | 0                    | 0           | 0          | 0           | 0                      | 0                      | 0           | 0   | 0        |            | (59)         |
|              |                     |              |                    |                      |             |            |             |                        |                        |             |   |          | -          |              |

| Combi                 | loss ca               | alculated                | for ea   | ch   | month (    | (61)m =   | (60   | )) ÷ 36            | 65 × (41)              | )m       |               |            |                    |              |            |                     |      |
|-----------------------|-----------------------|--------------------------|----------|------|------------|-----------|-------|--------------------|------------------------|----------|---------------|------------|--------------------|--------------|------------|---------------------|------|
| (61)m=                | 41.59                 | 36.2                     | 38.57    | 7    | 35.86      | 35.54     | 3     | 32.93              | 34.03                  | 35.54    | 4 35.86       | 6          | 38.57              | 38.79        | 41.59      | 7                   | (61) |
| Total h               | eat rec               | uired for                | water    | he   | ating ca   | alculated | d fo  | or eacl            | n month                | (62)m    | i = 0.85 :    | × (4       | 45)m +             | (46)m +      | (57)m ·    | <br>+ (59)m + (61)r | n    |
| (62)m=                | 162.63                | 142.06                   | 147.8    | 1    | 131.1      | 126.93    | 1     | 11.79              | 107.1                  | 119.4    | 4 120.7       | '1         | 137.46             | 146.73       | 158.81     |                     | (62) |
| Solar DH              | -IW input             | calculated               | using A  | ppe  | endix G or | Appendi   | хH    | (negativ           | ve quantity            | /) (ente | '0' if no so  | olar       | contribu           | tion to wate | er heating | g)                  |      |
| (add a                | dditiona              | al lines if              | FGHR     | Sa   | and/or V   | WHR       | S ap  | oplies             | see Ap                 | pendi    | (G)           |            |                    |              |            | _                   |      |
| (63)m=                | 0                     | 0                        | 0        |      | 0          | 0         |       | 0                  | 0                      | 0        | 0             |            | 0                  | 0            | 0          |                     | (63) |
| Output                | from v                | vater hea                | ter      |      |            |           |       |                    |                        |          |               |            |                    |              |            | _                   |      |
| (64)m=                | 162.63                | 142.06                   | 147.8    | 1    | 131.1      | 126.93    | 1     | 11.79              | 107.1                  | 119.4    | 120.7         | '1         | 137.46             | 146.73       | 158.81     |                     | _    |
|                       |                       |                          |          |      |            |           |       |                    |                        | C        | utput from    | wat        | ter heate          | er (annual)  | 112        | 1612.53             | (64) |
| Heat g                | ains fro              | om water                 | heatin   | ng,  | kWh/mo     | onth 0.2  | 5 ´   | [0.85              | × (45)m                | + (61    | )m] + 0.8     | 8 x        | [(46)m             | ı + (57)m    | + (59)r    | m ]                 |      |
| (65)m=                | 50.64                 | 44.25                    | 45.96    | 6    | 40.63      | 39.27     | 3     | 34.45              | 32.8                   | 36.77    | 7 37.18       | 3          | 42.52              | 45.59        | 49.37      |                     | (65) |
| inclu                 | ide (57               | )m in calo               | culatio  | n o  | f (65)m    | only if a | cylii | nder is            | s in the o             | dwellir  | ng or hot     | wa         | ater is f          | rom com      | munity     | heating             |      |
| 5. Int                | ternal g              | ains (see                | e Table  | e 5  | and 5a)    | ):        |       |                    |                        |          |               |            |                    |              |            |                     |      |
| Metab                 | olic gai              | ns (Table                | e 5), W  | att  | S          |           |       |                    |                        |          |               |            |                    |              | -          | _                   |      |
|                       | Jan                   | Feb                      | Ма       | r    | Apr        | May       |       | Jun                | Jul                    | Au       | g Sep         | р          | Oct                | Nov          | Dec        | ;                   |      |
| (66)m=                | 84.21                 | 84.21                    | 84.21    |      | 84.21      | 84.21     | ٤     | 34.21              | 84.21                  | 84.2     | 84.21         | 1          | 84.21              | 84.21        | 84.21      |                     | (66) |
| Ligh <mark>tin</mark> | g gains               | s (calcula               | ted in   | Ap   | pendix l   | L, equa   | tion  | L9 oi              | <sup>r</sup> L9a), a   | lso se   | e Table       | 5          |                    |              |            |                     |      |
| (67)m=                | 1 <mark>3.08</mark>   | 11.62                    | 9.45     |      | 7.15       | 5.35      |       | <mark>4</mark> .51 | 4.88                   | 6.34     | 8.51          |            | 10.8               | 12.61        | 13.44      |                     | (67) |
| App <mark>lia</mark>  | nces ga               | ains (ca <mark>lc</mark> | ulated   | lin  | Append     | dix L, ec | Jua   | tion L'            | 13 o <mark>r L1</mark> | 3a), a   | so see T      | Гab        | ole <mark>5</mark> |              |            |                     |      |
| (68)m=                | 1 <mark>4</mark> 6.71 | 148.2 <mark>4</mark>     | 144.4    | 1    | 136.23     | 125.92    | 1     | 16.23              | 109.76                 | 108.2    | 4 112.0       | 7          | 120.24             | 130.55       | 140.24     |                     | (68) |
| Cookir                | ng gains              | s (calcula               | ated in  | Ap   | pendix     | L, equa   | tior  | L15 ו              | or L15a)               | , also   | see Tab       | ole :      | 5                  |              | -          |                     |      |
| (69)m=                | 31.42                 | 31.42                    | 31.42    | 2    | 31.42      | 31.42     | 3     | 31.42              | 31.42                  | 31.42    | 31.42         | 2          | 31.42              | 31.42        | 31.42      | 7                   | (69) |
| Pumps                 | and fa                | ans gains                | (Table   | ə 5  | a)         |           |       |                    |                        |          |               |            |                    |              |            |                     |      |
| (70)m=                | 3                     | 3                        | 3        |      | 3          | 3         |       | 3                  | 3                      | 3        | 3             |            | 3                  | 3            | 3          |                     | (70) |
| Losses                | s e.g. e              | vaporatic                | on (neg  | gati | ve valu    | es) (Tal  | ble   | 5)                 |                        |          | -             |            |                    |              | -          |                     |      |
| (71)m=                | -67.37                | -67.37                   | -67.3    | 7    | -67.37     | -67.37    | -     | 67.37              | -67.37                 | -67.3    | 7 -67.3       | 7          | -67.37             | -67.37       | -67.37     |                     | (71) |
| Water                 | heating               | g gains (T               | able 5   | 5)   |            |           |       |                    |                        |          | -             |            |                    | -            | -          | _                   |      |
| (72)m=                | 68.07                 | 65.85                    | 61.78    | 3    | 56.43      | 52.78     | 4     | 17.85              | 44.09                  | 49.42    | 2 51.64       | 4          | 57.15              | 63.32        | 66.36      |                     | (72) |
| Total i               | nterna                | l gains =                |          |      |            |           |       | (66)               | m + (67)m              | ı + (68) | m + (69)m     | + (7       | 70)m + (1          | 71)m + (72)  | -<br>)m    | _                   |      |
| (73)m=                | 279.13                | 276.97                   | 266.8    | 9    | 251.08     | 235.32    | 2     | 19.86              | 209.99                 | 215.2    | 6 223.4       | .8         | 239.46             | 257.74       | 271.31     | 7                   | (73) |
| 6. So                 | lar gain              | is:                      |          |      |            |           |       |                    |                        |          |               |            |                    |              |            |                     |      |
| Solar g               | ains are              | calculated               | using so | olar | flux from  | Table 6a  | and   | l associ           | ated equa              | tions to | convert to    | b the      | e applica          | ble orientat | tion.      |                     |      |
| Orienta               |                       | Access F                 |          |      | Area       |           |       | Flu                |                        |          | g_<br>Table C | <b>`</b> L | -                  | FF           |            | Gains               |      |
|                       |                       | Table 6d                 |          |      | m²         |           |       | 1 ac               | ole 6a                 |          | Table 6       | 30         | ا<br>              | Table 6c     |            | (W)                 | _    |
|                       | ast <mark>0.9x</mark> | 0.77                     |          | x    | 2.3        | 32        | x     | 3                  | 6.79                   | ×        | 0.63          |            | ×                  | 0.7          | =          | 26.09               | (77) |
| Southe                |                       | 0.77                     |          | x    | 2.3        | 32        | x     | 6                  | 2.67                   | ×        | 0.63          |            | _ × [              | 0.7          | =          | 44.44               | (77) |
| Southe                |                       | 0.77                     |          | x    | 2.3        | 32        | x     | 8                  | 5.75                   | x        | 0.63          |            | _ × [              | 0.7          | =          | 60.8                | (77) |
|                       | ast <mark>0.9x</mark> | 0.77                     |          | x    | 2.3        | 32        | x     | 10                 | 06.25                  | x        | 0.63          |            | _ × [              | 0.7          | =          | 75.33               | (77) |
| Southe                | ast <mark>0.9x</mark> | 0.77                     |          | x    | 2.3        | 32        | x     | 1                  | 19.01                  | x        | 0.63          |            | x                  | 0.7          | =          | 84.38               | (77) |

| Southe   | ast <mark>0.9x</mark>  | 0.77  | x  | 2.3   | 2  | x   | 11   | 18.15  | x  | 0.63   | x  | 0.7  | =   | -     | 83.77  | (77)   |
|--|--|---|--|---|--|---|--|--|--|--|--|--|---|-------|--------|--|
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x  | 2.3   | 2  | x   | 11   | 13.91  | x  | 0.63   | x  | 0.7  | =   | - [   | 80.76  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x  | 2.3   | 2  | x   | 10   | 04.39  | x  | 0.63   | x  | 0.7  | =   | - [   | 74.02  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x  | 2.3   | 2  | x   | 9  | 2.85   | x  | 0.63   | ×  | 0.7  | =   | - [   | 65.83  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x  | 2.3   | 2  | x   | 6  | 9.27   | x  | 0.63   | ×  | 0.7  | =   | Ē     | 49.11  | (77)   |
| Southe   | ast 0.9x   | 0.77  | x  | 2.3   | 2  | x   | 4  | 4.07   | x  | 0.63   | ×  | 0.7  | =   | - Г   | 31.25  | (77)   |
| Southe   | ast 0.9x   | 0.77  | x  | 2.3   | 2  | x   | 3  | 1.49   | x  | 0.63   | ×  | 0.7  | =   | - Ē   | 22.33  | (77)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 3  | 6.79   | i  | 0.63   | ×  | 0.7  |   | - T   | 113.91 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 6  | 2.67   | İ  | 0.63   | ×  | 0.7  | =   | - Г   | 194.03 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 8  | 5.75   | i  | 0.63   | ×  | 0.7  | =   | - Г   | 265.48 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 1(   | 06.25  | i  | 0.63   | ×  | 0.7  |   | - Ē   | 328.94 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 1'   | 19.01  | 1  | 0.63   | ×  | 0.7  | =   | - Г   | 368.44 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 1'   | 18.15  | 1  | 0.63   | × ٦  | 0.7  |   | - F   | 365.78 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 1'   | 13.91  | 1  | 0.63   | ×  | 0.7  |   | - F   | 352.65 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  |  | x   |  | 04.39  |  | 0.63   | ×  | 0.7  |   | - 1   | 323.18 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | ×  | 10.1  | 13   | x   | 9  | 2.85   | ĺ  | 0.63   | × ٦  | 0.7  |   | - F   | 287.46 | (79)   |
| Southw   | /est <mark>0.9x</mark>   | 0.77  | x  | 10.1  | 13   | x   | 6  | 9.27   | 1  | 0.63   | ×  | 0.7  |   | - F   | 214.44 | (79)   |
| Sout <mark>hw</mark>   | /est <sub>0.9x</sub>   | 0.77  | x  | 10.1  | 13   | X   | 4  | 4.07   |  | 0.63   | x  | 0.7  | =   | Ē     | 136.44 | (79)   |
| Southw   | /est <sub>0.9x</sub>   | 0.77  | ×  | 10.1  |  | x   | 3  | 1.49   |  | 0.63   | ×  | 0.7  |   |       | 97.48  | (79)   |
|  | L L  |   |  |   |  |   | <u> </u>   |  |  |  | _  |  |   |       |        |  |
| Solar  | noine in i   | watta aala  | ulata d  | for cool  | a manth  |   |  |  | (92)   | $C_{\rm H}$ (7.4) m  | (00)~~   |  |   |       |        |  |
| Solar  | ains in '  | watts, <mark>calc</mark>  | luated   | tor eac   | n montr  |   |  |  | (83)m  | = Sum(74)m.  | (82)m  |  |   |       |        |  |
|  | í  |   |  |   |  | -   | 10 55  | 133 /1   | <u> </u>   |  | × ′  | 167.68   | 110.81  | 1     |        | (83)   |
| (83)m=   | 140  | 238.47 3  | 326.28   | 404.27  | 452.82   | 44  | 49.55<br>83)m  | 433.41<br>watts  | 397  |  | 263.5  | 5 167.68   | 119.81  | 1     |        | (83)   |
| (83)m=<br>Total ູ  | 140<br>Jains — ir  | 238.47 3<br>nternal and   | 326.28<br>d solar  | 404.27<br>(84)m =   | 452.82<br>= (73)m  | 44<br>+ (8  | 83)m   | , watts  | 397  | 19 353.29  | 263.5  |  | I   |       |        |  |
| (83)m=<br>Total (<br>(84)m=  | 140<br>jains — ir<br>419.12  | 238.47 3<br>nternal and<br>515.43 5   | 326.28<br>d solar<br>593.17  | 404.27<br>(84)m =<br>655.36   | 452.82<br>= (73)m<br>688.14  | 44<br>+ (8  |  |  | <u> </u>   | 19 353.29  | × ′  |  | 119.81<br>391.12  |       |        | (83)<br>(84)   |
| (83)m=<br>Total (<br>(84)m=<br>7. Me   | 140<br>Jains – ir<br>419.12<br>Pan inter   | 238.47 3<br>nternal and<br>515.43 5<br>nal temper   | 326.28<br>d solar<br>593.17<br>rature (  | 404.27<br>(84)m =<br>655.36<br>(heating   | 452.82<br>= (73)m<br>688.14<br>seasor  | 44<br>+ (8<br>66  | 83)m<br>69.41  | , watts<br>643.4   | 397<br>612   | 19         353.29           45         576.77  | 263.5  |  | I   |       |        | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp   | 140<br>Jains – ir<br>419.12<br>Dean inter  | 238.47 3<br>nternal and<br>515.43 5<br>nal temper<br>during hea   | 326.28<br>d solar<br>593.17<br>rature (<br>ating po  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in  | 452.82<br>(73)m<br>688.14<br>seasor<br>the live  | 44<br>+ (8<br>66  | 83)m<br>69.41<br>area f  | , watts<br>643.4<br>from Tat   | 397<br>612   | 19         353.29           45         576.77  | 263.5  |  | I   |       | 21     |  |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp   | 140<br>Jains – Ii<br>419.12<br>Dean inter<br>Derature<br>ation fac   | 238.47 3<br>nternal and<br>515.43 5<br>nal temper<br>during hea<br>tor for gain   | 326.28<br>d solar<br>593.17<br>rature (<br>ating points for li   | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are   | 452.82<br>(73)m<br>688.14<br>seasor<br>the livi<br>ea, h1,n  | 44<br>+ (8<br>60<br>n)<br>ing a   | 83)m<br>69.41<br>area f<br>ee Ta   | , watts<br>643,4<br>from Tab<br>ble 9a)  | 397<br>612   | 19 353.29<br>45 576.77<br>Th1 (°C)   | 263.5  | 2 425.43   | I   |       | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp   | 140<br>Jains – ir<br>419.12<br>Dean inter  | 238.47 3<br>nternal and<br>515.43 5<br>nal temper<br>during hea   | 326.28<br>d solar<br>593.17<br>rature (<br>ating po  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in  | 452.82<br>(73)m<br>688.14<br>seasor<br>the livi  | 44<br>+ (8<br>60<br>n)<br>ing a<br>n (se  | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun  | , watts<br>643.4<br>from Tat   | 397<br>612<br>ble 9,   | 19         353.29           45         576.77  | 263.5  | 2 425.43   | I   | <br>2 | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp   | 140<br>Jains – Ii<br>419.12<br>Dean inter<br>Derature<br>ation fac   | 238.47 3<br>Internal and<br>515.43 5<br>nal temper<br>during hea<br>tor for gain<br>Feb   | 326.28<br>d solar<br>593.17<br>rature (<br>ating points for li   | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are   | 452.82<br>(73)m<br>688.14<br>seasor<br>the livi<br>ea, h1,n  | 44<br>+ (8<br>60<br>n)<br>ing a<br>n (se  | 83)m<br>69.41<br>area f<br>ee Ta   | , watts<br>643,4<br>from Tab<br>ble 9a)  | 397<br>612<br>ble 9,   | 19 353.29<br>45 576.77<br>Th1 (°C)<br>Jg Sep   | 263.5  | 2 425.43   | 391.12  | <br>2 | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=  | 140<br>Jains – ir<br>419.12<br>Derature<br>Derature<br>Ation fac<br>Jan<br>0.99  | 238.47 3<br>Internal and<br>515.43 5<br>nal temper<br>during hea<br>tor for gain<br>Feb   | 326.28<br>solar<br>593.17<br>rature (<br>ating puns for li<br>Mar<br>0.89  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>ving are<br>Apr<br>0.76   | 452.82<br>= (73)m<br>688.14<br>seasor<br>the livition<br>ea, h1,n<br>May<br>0.58   | 44<br>+ (8<br>66<br>n)<br>ing (so   | 83)m<br>89.41<br>area f<br>ee Ta<br>Jun<br>0.41  | , watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29   | 397<br>612<br>ble 9,<br>Ai<br>0.3  | 19     353.29       45     576.77       Th1 (°C)       Jg     Sep       2     0.51   | 263.5<br>503.0   | 2 425.43<br>Nov  | 391.12<br>Dec   | <br>2 | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=  | 140<br>Jains – ir<br>419.12<br>Derature<br>Derature<br>Ation fac<br>Jan<br>0.99  | 238.47 3<br>nternal and<br>515.43 5<br>nal temper<br>during hea<br>tor for gain<br>Feb<br>0.96<br>I temperat  | 326.28<br>solar<br>593.17<br>rature (<br>ating puns for li<br>Mar<br>0.89  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>ving are<br>Apr<br>0.76   | 452.82<br>= (73)m<br>688.14<br>seasor<br>the livition<br>ea, h1,n<br>May<br>0.58   | 44<br>+ (8<br>66<br>n)<br>ing (so   | 83)m<br>89.41<br>area f<br>ee Ta<br>Jun<br>0.41  | , watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29   | 397<br>612<br>ble 9,<br>Ai<br>0.3  | 19       353.29         45       576.77         Th1 (°C)   | 263.5<br>503.0   | 2 425.43<br>Nov<br>0.97  | 391.12<br>Dec   | <br>2 | 21     | (84)   |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | 140<br>jains – in<br>419.12<br>ean inter<br>perature<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35   | 238.473anternal and515.435nal temperduring heator for gainFeb0.96temperati20.56   | 326.28<br>593.17<br>rature (<br>ating points for li<br>Mar<br>0.89<br>ure in l<br>20.78  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are<br>Apr<br>0.76<br>iving are<br>20.93  | 452.82<br>= (73)m<br>688.14<br>seasor<br>the livities, h1,n<br>May<br>0.58<br>ea T1 (f<br>20.99  | 44<br>+ (((<br>60<br>n)<br>ing ()<br>ing ()<br>ing ()<br>ing ()<br>ing ()   | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21   | , watts<br>643,4<br>From Tat<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21  | 397<br>612<br>0le 9,<br>0.3<br>7 in T<br>2   | 19       353.29         45       576.77         Th1 (°C)   | 263.5<br>503.0   | 2 425.43<br>Nov<br>0.97  | 391.12<br>Dec<br>0.99                                   | <br>2 | 21     | (84)<br>(85)<br>(86)                                 |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | 140<br>jains – in<br>419.12<br>ean inter<br>perature<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35   | 238.47 3<br>nternal and<br>515.43 5<br>nal temper<br>during hea<br>tor for gain<br>Feb<br>0.96<br>I temperati<br>20.56 5<br>during hea  | 326.28<br>593.17<br>rature (<br>ating points for li<br>Mar<br>0.89<br>ure in l<br>20.78  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are<br>Apr<br>0.76<br>iving are<br>20.93  | 452.82<br>= (73)m<br>688.14<br>seasor<br>the livities, h1,n<br>May<br>0.58<br>ea T1 (f<br>20.99  | 44<br>+ (()<br>66<br>n)<br>ing ;<br>follo   | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21   | , watts<br>643,4<br>From Tat<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21  | 397<br>612<br>0le 9,<br>0.3<br>7 in T<br>2   | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)   | 263.5<br>503.0   | 2 425.43<br>Nov<br>0.97<br>20.61   | 391.12<br>Dec<br>0.99                                   |       | 21     | (84)<br>(85)<br>(86)                                 |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mear<br>(87)m=<br>Temp<br>(88)m=  | 140<br>pains – in<br>419.12<br>perature<br>ation fac<br>Jan<br>0.99<br>n interna<br>20.35<br>perature<br>20.17   | 238.473Internal and515.435nal temperduring heator for gainFeb0.96I temperati20.56during hea20.17  | 326.28<br>solar<br>593.17<br>rature (<br>ating points for li<br>Mar<br>0.89<br>ure in l<br>20.78<br>ating points<br>20.18  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>ving are<br>Apr<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19   | 452.82<br>(73)m<br>688.14<br>seasor<br>the livities, h1,n<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19  | 44<br>+ (8<br>66<br>n)<br>ing a<br>n (se<br>collo   | area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2   | , watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2   | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>ble §<br>20.   | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)   | 263.5<br>503.0<br>0ct<br>0.81<br>20.91                                   | 2 425.43<br>Nov<br>0.97<br>20.61   | 391.12<br>Dec<br>0.99<br>20.3                           |       | 21     | (84)<br>(85)<br>(86)<br>(87)                         |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa                             | 140<br>pains – in<br>419.12<br>perature<br>ation fac<br>Jan<br>0.99<br>n interna<br>20.35<br>perature<br>20.17   | 238.473internal and515.43515.43al temperduring headuring heator for gainFeb0.96l temperati20.56during hea20.17tor for gain  | 326.28<br>solar<br>593.17<br>rature (<br>ating po-<br>ns for li<br>Mar<br>0.89<br>ure in l<br>20.78<br>ating po-<br>20.18<br>ns for r  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>0.76<br>iving are<br>20.93<br>eriods ir<br>20.19<br>est of du  | 452.82<br>(73)m<br>688.14<br>seasor<br>the livities, h1,n<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,                              | 44<br>+ (8<br>66<br>n)<br>ing (si<br>collo  | area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2   | , watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2   | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>ble §<br>20.   | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       20.19   | 263.5<br>503.0<br>0ct<br>0.81<br>20.91                                   | 2 425.43<br>Nov<br>0.97<br>20.61   | 391.12<br>Dec<br>0.99<br>20.3                           |       | 21     | (84)<br>(85)<br>(86)<br>(87)                         |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=                   | 140         gains – in         419.12         can inter         can internal         0.99         internal         20.35         cerature         20.17         ation fac         0.98 | 238.473anternal and515.435nal temperduring heaetor for gainFeb0.96I temperati20.56during hea20.17etor for gain0.95  | 326.28<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>s | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>ving are<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19<br>est of dv<br>0.72   | 452.82<br>(73)m<br>688.14<br>seasor<br>the livities, h1,m<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53                      | 44<br>+ (8<br>66<br>n)<br>ing 5<br>ing 5<br>collo   | 83)m<br>89.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>m (se<br>0.36                   | , watts<br>643,4<br>From Tak<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24                     | 397           612           612           ble 9,           0.3           7 in T           2'           ble 9           0.3           7 in T           2'           9a)           0.2 | 19       353.29         45       576.77         Th1 (°C)         ug       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       0.19         7       0.46   | 263.5<br>503.0<br>503.0<br>0.81<br>20.91<br>20.19                        | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18  | 391.12<br>Dec<br>0.99<br>20.3<br>20.18                  |       | 21     | (84)<br>(85)<br>(86)<br>(87)<br>(88)                 |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mear<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=<br>Mear           | 140         gains – in         419.12         can inter         berature         ation fac         Jan         0.99         interna         20.35         berature         20.17         ation fac         0.98         interna  | 238.473Internal and515.435nal temperduring heator for gainFeb0.96I temperate20.56during hea20.17tor for gain0.95I temperate   | 326.28       solar       ating provided       0.89       ure in I       20.78       ating provided       20.18       ns for r       0.87       ure in t  | 404.27 (84)m = 655.36 (heating are a second seco | 452.82<br>(73)m<br>688.14<br>seasor<br>the livition<br>ea, h1,n<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53<br>of dwell    | 44<br>+ (8<br>66<br>n)<br>ing (se<br>f dw<br>f dw<br>h2,<br>(<br>ling   | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>m (se<br>0.36<br>T2 (fo         | , watts<br>643,4<br>from Tat<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24<br>pllow ste        | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>0.3<br>90<br>0.2<br>90<br>0.2<br>90<br>90<br>0.2   | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       0.19         7       0.46         to 7 in Table   | 263.5<br>503.0<br>503.0<br>0.81<br>20.91<br>20.19<br>0.77<br>e 9c)       | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96  | 391.12<br>Dec<br>0.99<br>20.3<br>20.18<br>0.99          |       | 21     | (84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(89)         |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=                   | 140         gains – in         419.12         can inter         can internal         0.99         internal         20.35         cerature         20.17         ation fac         0.98 | 238.473Internal and515.435nal temperduring heator for gainFeb0.96I temperate20.56during hea20.17tor for gain0.95I temperate   | 326.28<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>s | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>ving are<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19<br>est of dv<br>0.72   | 452.82<br>(73)m<br>688.14<br>seasor<br>the livities, h1,m<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53                      | 44<br>+ (8<br>66<br>n)<br>ing (se<br>f dw<br>f dw<br>h2,<br>(<br>ling   | 83)m<br>89.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>m (se<br>0.36                   | , watts<br>643,4<br>From Tak<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24                     | 397           612           612           ble 9,           0.3           7 in T           2'           ble 9           0.3           7 in T           2'           9a)           0.2 | 19       353.29         45       576.77         Th1 (°C)   | 263.5<br>503.0<br>0ct<br>0.81<br>20.91<br>20.19<br>0.77<br>e 9c)<br>20.1 | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96<br>19.7  | 391.12<br>Dec<br>0.99<br>20.3<br>20.18<br>0.99<br>19.26 |       |        | (84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(89)<br>(90) |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mear<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=<br>Mear           | 140         gains – in         419.12         can inter         berature         ation fac         Jan         0.99         interna         20.35         berature         20.17         ation fac         0.98         interna  | 238.473Internal and515.435nal temperduring heator for gainFeb0.96I temperate20.56during hea20.17tor for gain0.95I temperate   | 326.28       solar       ating provided       0.89       ure in I       20.78       ating provided       20.18       ns for r       0.87       ure in t  | 404.27 (84)m = 655.36 (heating are a second seco | 452.82<br>(73)m<br>688.14<br>seasor<br>the livition<br>ea, h1,n<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53<br>of dwell    | 44<br>+ (8<br>66<br>n)<br>ing (se<br>f dw<br>f dw<br>h2,<br>(<br>ling   | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>m (se<br>0.36<br>T2 (fo         | , watts<br>643,4<br>from Tat<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24<br>pllow ste        | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>0.3<br>90<br>0.2<br>90<br>0.2<br>90<br>90<br>0.2   | 19       353.29         45       576.77         Th1 (°C)   | 263.5<br>503.0<br>0ct<br>0.81<br>20.91<br>20.19<br>0.77<br>e 9c)<br>20.1 | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96  | 391.12<br>Dec<br>0.99<br>20.3<br>20.18<br>0.99<br>19.26 |       | 21     | (84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(89)         |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mear<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=<br>Mear<br>(90)m= | 140         gains – ir         419.12         can inter         can inter         can inter         can inter         can inter         can interna         0.99         interna         20.35         canature         20.17         ation fac         0.98         interna         19.32                           | 238.473Internal and515.435nal temperduring heator for gainFeb0.96I temperati20.17tor for gain0.95I temperati19.62   | 326.28<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>s | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>ving are<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19<br>est of dv<br>0.72<br>he rest<br>20.12   | 452.82<br>(73)m<br>688.14<br>seasor<br>the livities, h1,m<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53<br>of dwell<br>20.18 | 44<br>+ (8<br>60<br>1)<br>ing 5<br>f dw<br>h2,<br>(1)<br>h2,<br>(1)<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10 | 83)m<br>89.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>relling<br>20.2<br>m (se<br>0.36<br>T2 (fc<br>20.2 | , watts<br>643,4<br>From Tak<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24<br>blow ste<br>20.2 | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>8<br>8<br>8<br>9<br>9<br>9<br>9<br>9<br>9<br>20<br>9<br>20<br>9<br>20  | 19       353.29         45       576.77         Th1 (°C)   | 263.5<br>503.0<br>0ct<br>0.81<br>20.91<br>20.19<br>0.77<br>e 9c)<br>20.1 | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96<br>19.7  | 391.12<br>Dec<br>0.99<br>20.3<br>20.18<br>0.99<br>19.26 |       |        | (84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(89)<br>(90) |
| (83)m=<br>Total (<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mear<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=<br>Mear<br>(90)m= | 140         gains – ir         419.12         can inter         can inter         can inter         can inter         can inter         can interna         0.99         interna         20.35         canature         20.17         ation fac         0.98         interna         19.32                           | 238.47       3         Internal and       5         515.43       5         nal temper         during hea         tor for gain         Feb         0.96         I temperate         20.56         during hea         20.17         tor for gain         0.95         I temperate         19.62         I temperate | 326.28<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>solar<br>s | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>ving are<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19<br>est of dv<br>0.72<br>he rest<br>20.12   | 452.82<br>(73)m<br>688.14<br>seasor<br>the livities, h1,m<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53<br>of dwell<br>20.18 | 44<br>+ (8<br>66<br>n (so<br>collo<br>f dw<br>h2,<br>(<br>ing<br>f dw   | 83)m<br>89.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>relling<br>20.2<br>m (se<br>0.36<br>T2 (fc<br>20.2 | , watts<br>643,4<br>From Tak<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24<br>blow ste<br>20.2 | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>8<br>8<br>8<br>9<br>9<br>9<br>9<br>9<br>9<br>20<br>9<br>20<br>9<br>20  | 19       353.29         19       353.29         45       576.77         Th1 (°C)       Jg         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       0.19         7       0.46         to 7 in Tabl       2         2       20.19         f       - fLA) × T2 | 263.5<br>503.0<br>0ct<br>0.81<br>20.91<br>20.19<br>0.77<br>e 9c)<br>20.1 | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96<br>19.7<br>ving area ÷ (vince the second se | 391.12<br>Dec<br>0.99<br>20.3<br>20.18<br>0.99<br>19.26 |       |        | (84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(89)<br>(90) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

|                                |            |               |           |           |            |           |                           |                     |            |                         |            | I                        | (02)  |
|--------------------------------|------------|---------------|-----------|-----------|------------|-----------|---------------------------|---------------------|------------|-------------------------|------------|--------------------------|-------|
| (93)m= 19.8                    | 20.06      | 20.32         | 20.5      | 20.56     | 20.57      | 20.57     | 20.57                     | 20.57               | 20.48      | 20.12                   | 19.75      |                          | (93)  |
| 8. Space hea<br>Set Ti to the  | Ŭ I        |               |           | ro obtoir | od at at   | on 11 of  | Toble O                   | o oo tha            | + Ti m_(   | 76)m.on                 | d ro oolo  | vulata                   |       |
| the utilisation                |            |               |           |           | ieu al Sie | эрттог    | Table 9                   | 0, 50 ina           | t 11,111=( | <i>i</i> 0)111 att      | u re-caic  | Julate                   |       |
| Jan                            | Feb        | Mar           | Apr       | May       | Jun        | Jul       | Aug                       | Sep                 | Oct        | Nov                     | Dec        |                          |       |
| Utilisation fac                | tor for g  | ains, hm      | :         |           |            |           |                           | · · ·               |            |                         |            |                          |       |
| (94)m= 0.98                    | 0.95       | 0.87          | 0.73      | 0.55      | 0.38       | 0.27      | 0.29                      | 0.48                | 0.79       | 0.95                    | 0.99       |                          | (94)  |
| Useful gains,                  | hmGm       | , W = (94     | 4)m x (84 | 4)m       |            |           |                           |                     |            |                         | •          |                          |       |
| (95)m= 411.37                  | 488.43     | 518.72        | 479.89    | 381.6     | 256.86     | 171.09    | 179.31                    | 278.38              | 396.32     | 405.91                  | 385.93     |                          | (95)  |
| Monthly aver                   | age exte   | ernal tem     | perature  | e from Ta | able 8     |           |                           |                     |            |                         |            |                          |       |
| (96)m= 4.3                     | 4.9        | 6.5           | 8.9       | 11.7      | 14.6       | 16.6      | 16.4                      | 14.1                | 10.6       | 7.1                     | 4.2        |                          | (96)  |
| Heat loss rate                 | e for me   | an intern     | al tempe  | erature,  | Lm , W =   | =[(39)m : | x [(93)m                  | – (96)m             | ]          |                         |            |                          |       |
| (97)m= 690.84                  | 673.92     | 612.37        | 507.02    | 386.15    | 257.22     | 171.12    | 179.36                    | 279.87              | 430.8      | 570.78                  | 685.06     |                          | (97)  |
| Space heatin                   | i          | 1             |           | nonth, k  | Wh/mont    | h = 0.02  | 24 x [(97]                | )m – (95            |            | 1                       |            | I                        |       |
| (98)m= 207.93                  | 124.65     | 69.67         | 19.53     | 3.38      | 0          | 0         | 0                         | 0                   | 25.66      | 118.7                   | 222.56     |                          | _     |
|                                |            |               |           |           |            |           | Tota                      | l per year          | (kWh/yeai  | ) = Sum(9               | 8)15,912 = | 792.09                   | (98)  |
| Space heatin                   | ng require | ement in      | kWh/m²    | ²/year    |            |           |                           |                     |            |                         |            | 15.91                    | (99)  |
| 9a. Energy red                 | quiremer   | nts – Indi    | vidual h  | eating s  | vstems i   | ncluding  | micro-C                   | CHP)                |            |                         |            |                          |       |
| Space heati                    |            |               |           |           |            | <u> </u>  |                           |                     |            |                         |            |                          |       |
| Fraction of sp                 | -          | at from s     | econdar   | y/supple  | mentary    | system    |                           |                     |            |                         |            | 0                        | (201) |
| Fraction of s                  | oace hea   | at from m     | nain syst | em(s)     |            |           | (20 <mark>2)</mark> = 1 - | (201) =             |            |                         |            | 1                        | (202) |
| Fraction of to                 |            |               |           |           |            |           | (204) = (2)               | 02) × [1 –          | (203)] =   |                         |            | 1                        | (204) |
|                                |            | -             |           |           |            |           |                           |                     | ()]        |                         |            |                          |       |
| Efficiency of                  |            |               | -         |           |            |           |                           |                     |            |                         |            | 93.4                     | (206) |
| Efficiency of                  | seconda    | ry/supple     | ementar   | y heatin  | g system   | 1, %      |                           |                     |            |                         |            | 0                        | (208) |
| Jan                            | Feb        | Mar           | Apr       | May       | Jun        | Jul       | Aug                       | Sep                 | Oct        | Nov                     | Dec        | kWh/y                    | ear   |
| Space heatin                   | ř          | ement (c      |           | d above   | )          |           |                           |                     |            | i                       |            | 1                        |       |
| 207.93                         | 124.65     | 69.67         | 19.53     | 3.38      | 0          | 0         | 0                         | 0                   | 25.66      | 118.7                   | 222.56     |                          |       |
| (211)m = {[(98                 | 3)m x (20  | 04)] } x 1    | 00 ÷ (20  | )6)       |            |           |                           |                     |            |                         |            |                          | (211) |
| 222.62                         | 133.46     | 74.6          | 20.91     | 3.62      | 0          | 0         | 0                         | 0                   | 27.47      | 127.09                  | 238.29     |                          |       |
|                                |            |               |           |           |            |           | Tota                      | l (kWh/yea          | ar) =Sum(2 | 211) <sub>15,1012</sub> | 7          | 848.06                   | (211) |
| Space heatin                   | ng fuel (s | econdar       | y), kWh/  | month     |            |           |                           |                     |            |                         |            |                          |       |
| = {[(98)m x (20                | 01)]}x1    | 00 ÷ (20      | 8)        |           |            |           |                           |                     |            |                         | 1          | 1                        |       |
| (215)m= 0                      | 0          | 0             | 0         | 0         | 0          | 0         | 0                         | 0                   | 0          | 0                       | 0          |                          | _     |
|                                |            |               |           |           |            |           | Tota                      | l (kWh/yea          | ar) =Sum(2 | 215) <sub>15,1012</sub> | Ē          | 0                        | (215) |
| Water heating                  | g          |               |           |           |            |           |                           |                     |            |                         |            |                          |       |
| Output from w                  |            |               |           |           |            |           |                           |                     |            |                         |            | I                        |       |
| 162.63                         | 142.06     | 147.81        | 131.1     | 126.93    | 111.79     | 107.1     | 119.4                     | 120.71              | 137.46     | 146.73                  | 158.81     |                          | _     |
| Efficiency of w                | ater hea   | <b></b>       |           |           |            |           |                           |                     |            |                         |            | 80.3                     | (216) |
| (217)m= 85.67                  | 84.72      | 83.28         | 81.48     | 80.53     | 80.3       | 80.3      | 80.3                      | 80.3                | 81.74      | 84.52                   | 85.9       |                          | (217) |
| Fuel for water                 | •          |               |           |           |            |           |                           |                     |            |                         |            |                          |       |
| (219)m = (64)                  |            |               |           | 157.61    | 120.22     | 122.20    | 148.69                    | 150.33              | 168.17     | 173.6                   | 101 00     |                          |       |
| (219)m= 189.83                 | 167.68     | 177.48        | 160.9     | 137.01    | 139.22     | 133.38    |                           | 150.33<br>I = Sum(2 |            | 173.0                   | 184.88     | 4054 70                  |       |
| A mm                           |            |               |           |           |            |           | TUId                      | . – Ourri(2         |            | A/In /                  |            | 1951.76                  | (219) |
| Annual totals<br>Space heating |            | ad main       | system    | 1         |            |           |                           |                     | K          | Wh/year                 |            | <b>kWh/yea</b><br>848.06 |       |
|                                | ,          | - <i></i> ,an | 5,50011   | -         |            |           |                           |                     |            |                         |            | 0-0.00                   |       |

|   |                           |                                   |     |                                | 1      |
|---|---------------------------|-----------------------------------|-----|--------------------------------|--------|
| Water heating fuel used                           |                           |                                   |     | 1951.76                        |        |
| Electricity for pumps, fans and electric keep-hot |                           |                                   |     |                                |        |
| central heating pump:                             |                           |                                   | 30  | ]                              | (230c) |
| boiler with a fan-assisted flue                   |                           |                                   | 45  |                                | (230e) |
| Total electricity for the above, kWh/year         |                           | sum of (230a)(230g) =             |     | 75                             | (231)  |
| Electricity for lighting                          |                           |                                   |     | 230.99                         | (232)  |
| 12a. CO2 emissions – Individual heating systems   | including micro-C         | CHP                               |     |                                | -      |
|   | <b>Energy</b><br>kWh/year | <b>Emission fac</b><br>kg CO2/kWh | tor | <b>Emissions</b><br>kg CO2/yea | r      |
| Space heating (main system 1)                     | (211) x                   | 0.216                             | =   | 183.18                         | (261)  |
| Space heating (secondary)                         | (215) x                   | 0.519                             | =   | 0                              | (263)  |
| Water heating                                     | (219) x                   | 0.216                             | =   | 421.58                         | (264)  |
| Space and water heating                           | (261) + (262) + (263      | 3) + (264) =                      |     | 604.76                         | (265)  |
| Electricity for pumps, fans and electric keep-hot | (231) x                   | 0.519                             | =   | 38.93                          | (267)  |
| Electricity for lighting                          | (232) x                   | 0.519                             | =   | 119.88                         | (268)  |
| Total CO2, kg/year TER =                          |                           | sum of (265)(271) =               |     | 763.57<br>15.33                | (272)  |

| Assessor Name:Stroma FSAP 2012Software Version:Version: 1.0.4.23Software Name:Stroma FSAP 2012Software Version:Version: 1.0.4.23Property Address: Flat 4Address :3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON1. Overall dwelling dimensions:  |                |
|--|----------------|
| Address :       3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON         1. Overall dwelling dimensions:  |                |
| 1. Overall dwelling dimensions:  |                |
|  |                |
| Area(m²)Av. Height(m)Volume(m³)Ground floor92.6(1a) x2.5(2a) =231.5(3a)  | 3)             |
| Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ 92.6 (4)  |                |
| Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 231.5$ (5)  |                |
| 2. Ventilation rate:   |                |
| main<br>heatingsecondary<br>heatingothertotal $m^3$ per hourNumber of chimneys0+0+0=0x 40 =0(6a)Number of open flues0+0+0=0x 20 =0(6b)   |                |
| Number of intermittent fans $3 \times 10 = 30$ (7a)  | a)             |
|  |                |
|  |                |
| Air changes per hour   |                |
| Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 30 \div (5) = 0.13$ (8)<br>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)   |                |
| Number of storeys in the dwelling (ns)       0       (9)         Additional infiltration       0       (10)         Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction       0       (11)         if both types of wall are present, use the value corresponding to the greater wall area (after       0       (11)  | ))             |
| deducting areas of openings); if equal user 0.35   |                |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0  |                |
| If no draught lobby, enter 0.05, else enter 0  |                |
| Percentage of windows and doors draught stripped $0$ (14)Window infiltration $0.25 - [0.2 \times (14) \div 100] =$ $0$   |                |
| (0) + (40) + (42) + (42) + (45)  |                |
|  |                |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area<br>If based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$ 0.38 (18)  | ÷              |
| Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used   | <i>''</i>      |
| Number of sides sheltered 2 (19  | <del>)</del> ) |
| Shelter factor $(20) = 1 - [0.075 \times (19)] =$ $0.85$ $(20)$  | ))             |
|  | )              |
| Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ $0.32$ $(21)$   |                |
| Infiltration rate incorporating shelter factor       (21) = (18) x (20) =       0.32       (21)         Infiltration rate modified for monthly wind speed       (21)       (21)       (21)   |                |
|  |                |
| Infiltration rate modified for monthly wind speed  |                |
| Infiltration rate modified for monthly wind speed           Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec  |                |
| Infiltration rate modified for monthly wind speed          Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         Monthly average wind speed from Table 7       Image: Content of the second sec |                |

| Adjuste      | ed infiltr | ation rat                      | e (allow                   | ing for sh                | elter and    | d wind s       | peed) =     | (21a) x       | (22a)m       |               |                 |                    |           |               |
|--------------|------------|--------------------------------|----------------------------|---------------------------|--------------|----------------|-------------|---------------|--------------|---------------|-----------------|--------------------|-----------|---------------|
|              | 0.41       | 0.4                            | 0.4                        | 0.35                      | 0.35         | 0.31           | 0.31        | 0.3           | 0.32         | 0.35          | 0.36            | 0.38               |           |               |
|              |            | <i>ctive air</i><br>al ventila | •                          | rate for t                | he applic    | cable ca       | se          |               |              |               |                 |                    | 0         | (23a)         |
|              |            |                                |                            | endix N, (2               | 3b) = (23a   | ) × Fmv (e     | equation (  | N5)) , othe   | rwise (23b   | ) = (23a)     |                 |                    | 0         | (23b)         |
| lf bala      | anced wit  | n heat reco                    | overy: effic               | iency in %                | allowing for | or in-use f    | actor (fror | n Table 4h    | i) =         |               |                 |                    | 0         | (23c)         |
| a) If        | balance    | ed mech                        | anical ve                  | entilation                | with hea     | at recove      | ery (MV     | HR) (24a      | a)m = (22    | 2b)m + (1     | 23b) × [′       | l<br>1 – (23c)     | -         |               |
| ,<br>(24a)m= | 0          | 0                              | 0                          | 0                         | 0            | 0              | 0           | 0             | 0            | 0             | 0               | 0                  | -         | (24a)         |
| b) If        | balance    | d mech                         | anical ve                  | entilation                | without      | heat rec       | covery (I   | MV) (24t      | )m = (22     | 2b)m + (2     | 23b)            |                    | I         |               |
| (24b)m=      | 0          | 0                              | 0                          | 0                         | 0            | 0              | 0           | 0             | 0            | 0             | 0               | 0                  |           | (24b)         |
| c) If v      | whole h    | Iouse ex                       | tract ver                  | ntilation c               | or positiv   | e input v      | ventilatio  | on from o     | outside      |               |                 | •                  |           |               |
| i            | f (22b)r   | n < 0.5 >                      | <b>«</b> (23b), t          | then (24d                 | c) = (23b    | ); otherv      | wise (24    | c) = (22      | b) m + 0.    | 5 × (23b      | )               |                    |           |               |
| (24c)m=      | 0          | 0                              | 0                          | 0                         | 0            | 0              | 0           | 0             | 0            | 0             | 0               | 0                  |           | (24c)         |
| ,            |            |                                |                            | iole hous<br>m = (22t     |              | •              |             |               |              | 0.5]          |                 |                    |           |               |
| (24d)m=      | 0.58       | 0.58                           | 0.58                       | 0.56                      | 0.56         | 0.55           | 0.55        | 0.54          | 0.55         | 0.56          | 0.57            | 0.57               |           | (24d)         |
| Effec        | ctive air  | change                         | rate - er                  | nter (24a                 | ) or (24b    | ) or (24       | c) or (24   | d) in bo      | x (25)       | -             |                 | _                  |           |               |
| (25)m=       | 0.58       | 0.58                           | 0.58                       | 0.56                      | 0.56         | 0.55           | 0.55        | 0.54          | 0.55         | 0.56          | 0.57            | 0.57               |           | (25)          |
| 3. Hea       | at losse   | s and he                       | eat loss i                 | paramete                  | er:          |                |             |               |              |               |                 |                    |           | _             |
|              |            | Gros<br>area                   | ss                         | Openin<br>m               | gs           | Net Ar<br>A ,r |             | U-val<br>W/m2 |              | A X U<br>(W/I | <)              | k-value<br>kJ/m²·ł |           | A X k<br>kJ/K |
| Windo        | ws Type    |                                |                            |                           |              | 10.98          |             | /[1/( 1.4 )+  |              | 14.56         |                 |                    |           | (27)          |
|              | ws Type    |                                |                            |                           |              | 2.7            |             | /[1/( 1.4 )+  | · 0.04] =    | 3.58          | Ħ               |                    |           | (27)          |
|              | ws Type    |                                |                            |                           |              | 2.7            |             | /[1/( 1.4 )+  |              | 3.58          | Ħ               |                    |           | (27)          |
| Walls T      |            | 34.                            | 5                          | 10.98                     | 3            | 23.52          |             | 0.18          |              | 4.23          | H r             |                    |           | (29)          |
| Walls T      |            | 12.                            |                            | 2.7                       | ,<br>        | 9.8            | x           | 0.18          |              | 1.76          | =               |                    | $\exists$ | (29)          |
| Walls T      |            | 23.2                           |                            | 2.7                       |              | 20.55          |             | 0.18          |              | 3.7           | =               |                    | $\exists$ | (29)          |
|              |            | elements                       |                            | 2.1                       |              | 70.25          |             | 0.10          |              | 0.1           |                 |                    |           | (31)          |
| Party w      |            |                                | ,                          |                           |              | 47             | ,           | 0             | = [          | 0             |                 |                    |           | (32)          |
| Party fl     |            |                                |                            |                           |              | 92.6           | =           |               | I            |               | L<br>[          |                    | $\dashv$  | (32a)         |
| Party c      |            |                                |                            |                           |              | 92.6           |             |               |              |               | L<br>L          |                    | $\dashv$  | (32b)         |
| -            | l wall **  |                                |                            |                           |              | 146.5          |             |               |              |               | L<br>L          |                    | $\dashv$  | (32c)         |
| * for wind   | dows and   | l roof wind                    |                            | effective wil             |              | lue calcul     |             | g formula 1   | 1/[(1/U-valu | ie)+0.04] a   | L<br>s given in | paragraph          | 3.2       | (020)         |
|              |            |                                | = S (A x                   |                           |              |                |             | (26)(30       | ) + (32) =   |               |                 |                    | 31.41     | (33)          |
| Heat ca      | apacity    | Cm = S                         | (Axk)                      | ,                         |              |                |             |               | ((28)        | .(30) + (32   | 2) + (32a).     | (32e) =            | 19835     |               |
| Therma       | al mass    | parame                         | eter (TMI                  | ⊃ = Cm ÷                  | TFA) in      | ⊨kJ/m²K        |             |               | Indica       | tive Value    | Medium          |                    | 250       | (35)          |
|              | -          |                                | nere the de<br>tailed calc | etails of the<br>ulation. | constructi   | on are not     | t known pi  | recisely the  | e indicative | values of     | TMP in Ta       | able 1f            |           |               |
| Therma       | al bridg   | es : S (L                      | . x Y) cal                 | culated u                 | using Ap     | pendix ł       | <           |               |              |               |                 |                    | 5.39      | (36)          |
| if details   | of therma  | al bridging                    | are not kr                 | 10wn (36) =               | = 0.05 x (3  | 1)             |             |               |              |               |                 |                    |           |               |
| Total fa     | abric he   | at loss                        |                            |                           |              |                |             |               | (33) +       | (36) =        |                 |                    | 36.8      | (37)          |

| Ventila   | ation hea            | at loss ca | alculated  | monthl                  | у              |            |            |             | (38)m        | = 0.33 × (             | 25)m x (5)                            |         |         |      |
|-----------|----------------------|------------|------------|-------------------------|----------------|------------|------------|-------------|--------------|------------------------|---------------------------------------|---------|---------|------|
|           | Jan                  | Feb        | Mar        | Apr                     | May            | Jun        | Jul        | Aug         | Sep          | Oct                    | Nov                                   | Dec     |         |      |
| (38)m=    | 44.66                | 44.41      | 44.16      | 43.01                   | 42.79          | 41.79      | 41.79      | 41.6        | 42.17        | 42.79                  | 43.23                                 | 43.69   |         | (38) |
| Heat ti   | ransfer c            | coefficier | nt, W/K    |                         |                |            |            |             | (39)m        | = (37) + (3            | 38)m                                  |         |         |      |
| (39)m=    | 81.46                | 81.21      | 80.96      | 79.81                   | 79.59          | 78.59      | 78.59      | 78.4        | 78.97        | 79.59                  | 80.03                                 | 80.49   |         | _    |
| Heatle    |                      | motor (l   | ער ים ור   | /m21/                   |                |            |            |             |              | Average =<br>= (39)m ÷ | Sum(39) <sub>1</sub> .                | 12 /12= | 79.81   | (39) |
| (40)m=    | oss para<br>0.88     | 0.88       | 0.87       | 0.86                    | 0.86           | 0.85       | 0.85       | 0.85        | 0.85         | = (39)III ÷            | 0.86                                  | 0.87    |         |      |
| (40)11-   | 0.00                 | 0.00       | 0.07       | 0.00                    | 0.00           | 0.00       | 0.00       | 0.00        |              |                        | Sum(40)1.                             |         | 0.86    | (40) |
| Numbe     | er of day            | rs in moi  | nth (Tab   | le 1a)                  |                | -          |            |             | -            |                        |                                       |         |         |      |
|           | Jan                  | Feb        | Mar        | Apr                     | May            | Jun        | Jul        | Aug         | Sep          | Oct                    | Nov                                   | Dec     |         |      |
| (41)m=    | 31                   | 28         | 31         | 30                      | 31             | 30         | 31         | 31          | 30           | 31                     | 30                                    | 31      |         | (41) |
|           |                      |            |            |                         |                |            |            |             |              |                        |                                       |         |         |      |
| 4. Wa     | ater heat            | ing ene    | rgy requ   | irement:                |                |            |            |             |              |                        |                                       | kWh/ye  | ear:    |      |
| Assum     | ned occu             | ipancy. I  | N          |                         |                |            |            |             |              |                        | 2                                     | 66      |         | (42) |
| if TF     | A > 13.9             | 9, N = 1   |            | : [1 - exp              | (-0.0003       | 849 x (TF  | FA -13.9   | )2)] + 0.0  | 0013 x (     | TFA -13.               |                                       |         |         | ( )  |
|           | A £ 13.9             | ,          | ator usa   | no in litre             | e nor da       | ve hV ve   | orano -    | (25 x N)    | + 36         |                        | 07                                    | 07      |         | (42) |
|           |                      |            |            |                         |                |            |            | to achieve  |              | se target o            |                                       | .37     |         | (43) |
| not more  | e that 125           | litres per | person pe  | r day (all w            | ater use, l    | hot and co | ld)        |             |              |                        |                                       |         |         |      |
|           | Jan                  | Feb        | Mar        | Apr                     | May            | Jun        | Jul        | Aug         | Sep          | Oct                    | Nov                                   | Dec     |         |      |
|           |                      |            |            | ach m <mark>onth</mark> |                |            |            |             |              | i                      |                                       |         |         |      |
| (44)m=    | 107.1                | 103.21     | 99.31      | 95.42                   | 91.52          | 87.63      | 87.63      | 91.52       | 95.42        | 99.31                  | 103.21                                | 107.1   |         |      |
| Energy    | content of           | hot water  | used - ca  | lculated m              | onthly $= 4$ . | 190 x Vd,r | m x nm x E | OTm / 3600  |              |                        | m(44) <sub>112</sub> =<br>ables 1b, 1 |         | 1168.4  | (44) |
| (45)m=    | 158.83               | 138.92     | 143.35     | 124.97                  | 119.92         | 103.48     | 95.89      | 110.03      | 111.35       | 12 <mark>9.76</mark>   | 141.65                                | 153.82  |         |      |
| If instan | topoquo u            | otor hooti | ng ot poin | t of upp /m             | bot wata       | , otorogo) | ontor 0 in | hoven (16   |              | Total = Su             | m(45) <sub>112</sub> =                |         | 1531.96 | (45) |
|           |                      |            |            | ·                       |                |            |            | boxes (46)  |              | 40.40                  | 04.05                                 | 00.07   |         | (46) |
|           | 23.82<br>storage     |            | 21.5       | 18.75                   | 17.99          | 15.52      | 14.38      | 16.5        | 16.7         | 19.46                  | 21.25                                 | 23.07   |         | (46) |
|           | -                    |            | includir   | ng any se               | olar or W      | /WHRS      | storage    | within sa   | ame ves      | sel                    |                                       | 0       |         | (47) |
| If com    | munity h             | eating a   | ind no ta  | ank in dw               | velling, e     | nter 110   | litres in  | (47)        |              |                        |                                       |         |         |      |
|           |                      |            | hot wate   | er (this ir             | ncludes i      | nstantar   | neous co   | ombi boil   | ers) ente    | er '0' in (            | 47)                                   |         |         |      |
|           | storage              |            | eclared I  | oss facto               | or is kno      | wn (kWł    | n/dav).    |             |              |                        |                                       | 0       |         | (48) |
| ,         | erature fa           |            |            |                         |                |            | "day).     |             |              |                        |                                       | 0       |         | (49) |
| •         |                      |            |            | e, kWh/ye               | ear            |            |            | (48) x (49) | ) =          |                        |                                       | 0       |         | (50) |
|           |                      |            | -          | cylinder                |                | or is not  |            |             |              |                        |                                       | 0       |         | (/   |
|           |                      | -          |            | rom Tabl                | le 2 (kW       | h/litre/da | ay)        |             |              |                        |                                       | 0       |         | (51) |
|           | munity h<br>e factor | -          |            | on 4.3                  |                |            |            |             |              |                        |                                       | 0       |         | (52) |
|           | erature fa           |            |            | 2b                      |                |            |            |             |              |                        | <u> </u>                              | 0<br>0  |         | (52) |
| Energy    | y lost fro           | m water    | storage    | , kWh/ye                | ear            |            |            | (47) x (51) | ) x (52) x ( | 53) =                  |                                       | 0       |         | (54) |
|           | ,<br>(50) or (       |            | -          | ,                       |                |            |            |             |              |                        |                                       | 0       |         | (55) |
| Water     | storage              | loss cal   | culated    | for each                | month          |            |            | ((56)m = (  | 55) × (41)   | m                      |                                       |         |         |      |
| (56)m=    | 0                    | 0          | 0          | 0                       | 0              | 0          | 0          | 0           | 0            | 0                      | 0                                     | 0       |         | (56) |

| If cylinder contair         | ns dedicate               | d solar sto    | rage, (57)r         | m = (56)m | x [(50) – ( | H11)] ÷ (5               | 0), else (5  | 7)m = (56)    | m where (                 | H11) is fro   | m Append    | lix H         |      |
|-----------------------------|---------------------------|----------------|---------------------|-----------|-------------|--------------------------|--------------|---------------|---------------------------|---------------|-------------|---------------|------|
| (57)m= 0                    | 0                         | 0              | 0                   | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           |               | (57) |
| Primary circui              | t loss (ar                | nual) fro      | om Table            | 93        |             |                          |              |               |                           |               | 0           |               | (58) |
| Primary circui              |                           |                |                     |           | 59)m = (    | (58) ÷ 36                | 65 × (41)    | m             |                           |               |             |               |      |
| (modified b                 | y factor f                | rom Tab        | le H5 if t          | here is s | solar wat   | ter heatii               | ng and a     | cylinde       | r thermo                  | stat)         |             |               |      |
| (59)m= 0                    | 0                         | 0              | 0                   | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           | _             | (59) |
| Combi loss ca               | alculated                 | for each       | month (             | 61)m =    | (60) ÷ 36   | 65 × (41)                | )m           |               |                           |               |             |               |      |
| (61)m= 50.96                | 46.03                     | 50.61          | 47.06               | 46.64     | 43.21       | 44.66                    | 46.64        | 47.06         | 50.61                     | 49.32         | 50.96       |               | (61) |
| Total heat rec              | uired for                 | water he       | eating ca           | alculated | for eac     | h month                  | (62)m =      | 0.85 × (      | (45)m +                   | (46)m +       | (57)m +     | (59)m + (61)m | 1    |
| (62)m= 209.79               | 184.94                    | 193.96         | 172.03              | 166.56    | 146.69      | 140.54                   | 156.67       | 158.4         | 180.37                    | 190.96        | 204.78      |               | (62) |
| Solar DHW input             | calculated                | using App      | endix G or          | Appendix  | H (negati   | ve quantity              | /) (enter '0 | ' if no sola  | r contribut               | ion to wate   | er heating) |               |      |
| (add additiona              | al lines if               | FGHRS          | and/or V            | VWHRS     | applies     | , see Ap                 | pendix C     | G)            |                           |               |             |               |      |
| (63)m= 0                    | 0                         | 0              | 0                   | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           |               | (63) |
| Output from w               | vater hea                 | ter            |                     |           |             |                          |              |               |                           |               |             |               |      |
| (64)m= 209.79               | 184.94                    | 193.96         | 172.03              | 166.56    | 146.69      | 140.54                   | 156.67       | 158.4         | 180.37                    | 190.96        | 204.78      |               | _    |
|                             |                           |                |                     |           |             |                          | Outp         | out from wa   | ater heate                | r (annual)₁   | 12          | 2105.7        | (64) |
| Heat gains fro              | om water                  | heating,       | kWh/m               | onth 0.2  | 5´[0.85     | × (45)m                  | + (61)m      | n] + 0.8 >    | k [(46)m                  | + (57)m       | + (59)m     | ]             |      |
| (65)m= 65.55                | 57.7                      | 60.32          | 53. <mark>32</mark> | 51.53     | 45.21       | 43.05                    | 48.25        | 48.79         | 55.8                      | 59.43         | 63.88       |               | (65) |
| in <mark>clude</mark> (57)  | )m in c <mark>al</mark> o | culation of    | of (65)m            | only if c | ylinder i   | s in th <mark>e</mark> o | dwelling     | or hot w      | ate <mark>r is f</mark> r | om com        | munity h    | eating        |      |
| 5. Internal g               | ains (see                 | e Table 5      | and 5a              | ):        |             |                          |              |               |                           |               |             |               |      |
| Met <mark>abolic</mark> gai | ns (Table                 | <u>5), Wat</u> | ts                  |           |             |                          |              |               |                           |               |             |               |      |
| Jan                         | Feb                       | Mar            | Apr                 | May       | Jun         | Jul                      | Aug          | Sep           | Oct                       | Nov           | Dec         |               |      |
| (66)m= 132.98               | 132.98                    | 132.98         | 132.98              | 132.98    | 132.98      | 132.98                   | 132.98       | 132.98        | 132.98                    | 132.98        | 132.98      |               | (66) |
| Lighting gains              | calcula                   | ted in Ap      | pendix l            | L, equat  | ion L9 o    | r L9a), a                | lso see      | Table 5       | -                         |               |             |               |      |
| (67)m= 22.26                | 19.77                     | 16.08          | 12.17               | 9.1       | 7.68        | 8.3                      | 10.79        | 14.48         | 18.39                     | 21.46         | 22.88       |               | (67) |
| Appliances ga               | •                         |                |                     |           |             |                          | ,            | see Ta        | ble 5                     |               |             |               |      |
| (68)m= 243.78               | 246.31                    | 239.94         | 226.36              | 209.23    | 193.13      | 182.38                   | 179.85       | 186.22        | 199.79                    | 216.92        | 233.02      |               | (68) |
| Cooking gains               | s (calcula                | ted in A       | ppendix             | L, equat  | tion L15    | or L15a)                 | ), also se   | e Table       | 5                         |               |             |               |      |
| (69)m= 36.3                 | 36.3                      | 36.3           | 36.3                | 36.3      | 36.3        | 36.3                     | 36.3         | 36.3          | 36.3                      | 36.3          | 36.3        |               | (69) |
| Pumps and fa                | ins gains                 | (Table 5       | ōa)                 |           | -           | -                        | -            |               | -                         |               |             |               |      |
| (70)m= 3                    | 3                         | 3              | 3                   | 3         | 3           | 3                        | 3            | 3             | 3                         | 3             | 3           |               | (70) |
| Losses e.g. e               | vaporatic                 | on (negat      | tive valu           | es) (Tab  | ole 5)      | -                        | -            |               | -                         | -             |             |               |      |
| (71)m= -106.39              | -106.39                   | -106.39        | -106.39             | -106.39   | -106.39     | -106.39                  | -106.39      | -106.39       | -106.39                   | -106.39       | -106.39     |               | (71) |
| Water heating               | g gains (T                | able 5)        |                     |           |             |                          |              |               |                           |               |             |               |      |
| (72)m= 88.11                | 85.86                     | 81.07          | 74.05               | 69.26     | 62.79       | 57.86                    | 64.85        | 67.76         | 75                        | 82.54         | 85.87       |               | (72) |
| Total interna               | l gains =                 | :              |                     |           | (66)        | m + (67)m                | n + (68)m +  | + (69)m + (   | (70)m + (7                | 1)m + (72)    | m           | -             |      |
| (73)m= 420.04               | 417.83                    | 402.98         | 378.49              | 353.49    | 329.5       | 314.43                   | 321.38       | 334.36        | 359.07                    | 386.82        | 407.67      |               | (73) |
| 6. Solar gain               |                           |                |                     |           |             |                          |              |               |                           |               |             |               |      |
| Solar gains are             |                           | -              | r flux from         | Table 6a  |             |                          | itions to co | nvert to th   | e applicat                |               | ion.        |               |      |
| Orientation:                | Access F<br>Table 6d      | actor          | Area<br>m²          |           | Flu<br>Tal  | x<br>ble 6a              | т            | g_<br>able 6b | Та                        | FF<br>able 6c |             | Gains<br>(W)  |      |
|                             |                           |                |                     |           |             |                          |              |               |                           |               |             |               |      |

| Northeast 0.9x            | 0.77               | × | 2.7   | × | 11.28  | × | 0.63 | x | 0.7 | = | 9.31   | (75) |
|---------------------------|--------------------|---|-------|---|--------|---|------|---|-----|---|--------|------|
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 22.97  | × | 0.63 | x | 0.7 | = | 18.95  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 41.38  | x | 0.63 | x | 0.7 | = | 34.14  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 67.96  | × | 0.63 | x | 0.7 | = | 56.07  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 91.35  | × | 0.63 | x | 0.7 | = | 75.37  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 97.38  | x | 0.63 | x | 0.7 | = | 80.36  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | × | 91.1   | × | 0.63 | x | 0.7 | = | 75.17  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 72.63  | x | 0.63 | x | 0.7 | = | 59.93  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 50.42  | x | 0.63 | x | 0.7 | = | 41.6   | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 28.07  | × | 0.63 | x | 0.7 | = | 23.16  | (75) |
| Northeast 0.9x            | 0.77               | x | 2.7   | x | 14.2   | × | 0.63 | x | 0.7 | = | 11.71  | (75) |
| Northeast 0.9x            | 0.77               | × | 2.7   | x | 9.21   | × | 0.63 | x | 0.7 | = | 7.6    | (75) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 36.79  | × | 0.63 | x | 0.7 | = | 30.36  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 62.67  | × | 0.63 | x | 0.7 | = | 51.72  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 85.75  | × | 0.63 | x | 0.7 | = | 70.76  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 106.25 | x | 0.63 | x | 0.7 | = | 87.67  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 119.01 | x | 0.63 | x | 0.7 | = | 98.2   | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | X | 118.15 | x | 0.63 | x | 0.7 | = | 97.49  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | х | 113.91 | x | 0.63 | x | 0.7 | = | 93.99  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 104.39 | × | 0.63 | x | 0.7 | = | 86.14  | (77) |
| Southeast 0.9x            | 0.7 <mark>7</mark> | x | 2.7   | x | 92.85  | x | 0.63 | x | 0.7 | = | 76.62  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | × | 69.27  | х | 0.63 | × | 0.7 | = | 57.16  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 44.07  | × | 0.63 | x | 0.7 | = | 36.37  | (77) |
| Southeast 0.9x            | 0.77               | x | 2.7   | x | 31.49  | x | 0.63 | x | 0.7 | = | 25.98  | (77) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 36.79  |   | 0.63 | x | 0.7 | = | 123.47 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 62.67  |   | 0.63 | x | 0.7 | = | 210.31 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 85.75  |   | 0.63 | x | 0.7 | = | 287.75 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 106.25 |   | 0.63 | x | 0.7 | = | 356.54 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 119.01 |   | 0.63 | x | 0.7 | = | 399.36 | (79) |
| Southwest0.9x             | 0.77               | x | 10.98 | x | 118.15 |   | 0.63 | x | 0.7 | = | 396.47 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 113.91 |   | 0.63 | x | 0.7 | = | 382.24 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 104.39 |   | 0.63 | x | 0.7 | = | 350.3  | (79) |
| Southwest0.9x             | 0.77               | x | 10.98 | x | 92.85  |   | 0.63 | x | 0.7 | = | 311.58 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | × | 69.27  |   | 0.63 | x | 0.7 | = | 232.44 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | × | 44.07  |   | 0.63 | x | 0.7 | = | 147.88 | (79) |
| Southwest <sub>0.9x</sub> | 0.77               | x | 10.98 | x | 31.49  |   | 0.63 | x | 0.7 | = | 105.66 | (79) |

| Solar g  | Solar gains in watts, calculated for each month $(83)m = Sum(74)m \dots (82)m$ |           |            |                      |           |         |         |        |        |        |         |        |      |        |
|--|--|-----------|------------|----------------------|-----------|---------|---------|--------|--------|--------|---------|--------|------|--------|
| (83)m=   | 163.14   | 280.98    | 392.66     | 500.29               | 572.93    | 574.32  | 551.4   | 496.36 | 429.8  | 312.75 | 195.96  | 139.25 |      | (83)   |
| Total g  | ains – ii  | nternal a | nd solar   | <sup>-</sup> (84)m = | = (73)m - | ⊦ (83)m | , watts |        |        |        | · · · · |        | -    |        |
| (84)m=   | 583.18   | 698.81    | 795.64     | 878.77               | 926.42    | 903.82  | 865.83  | 817.74 | 764.16 | 671.83 | 582.78  | 546.91 |      | (84)   |
| 7. Mean internal temperature (heating season)  |  |           |            |                      |           |         |         |        |        |        |         |        |      |        |
| Temperature during heating periods in the living area from Table 9, Th1 (°C)   |  |           |            |                      |           |         |         |        |        |        |         | 21     | (85) |        |
| Utilisa  | ation fac  | tor for g | ains for l | iving are            | ea, h1,m  | (see Ta | ble 9a) |        |        |        |         |        |      |        |
| Utilisation factor for gains for living area, h1,m (see Table 9a)<br>Stroma FSAM 2012 VESDon 1.0423 (SAM 9.52) - http://www.stuma.com/ul Aug Sep Oct Nov Dec |  |           |            |                      |           |         |         |        |        |        |         |        | Page | 5 of 7 |

| (86)m=         1         0.99         0.97         0.9         0.75         0.55         0.4         0.44         0.69         0.94         0.99         1   | (86)                   |
|--|------------------------|
| Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)  |                        |
| (87)m= 20.17 20.34 20.57 20.81 20.95 20.99 21 21 20.98 20.79 20.43 20.14   | (87)                   |
| Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)  |                        |
| (88)m= 20.18 20.19 20.19 20.2 20.2 20.21 20.21 20.21 20.21 20.2 20.2   | (88)                   |
| Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)   |                        |
| (89)m= 1 0.99 0.96 0.88 0.7 0.49 0.33 0.37 0.62 0.91 0.99 1  | (89)                   |
| Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)   |                        |
| (90)m= 19.07 19.33 19.65 19.99 20.16 20.21 20.21 20.21 20.19 19.97 19.46 19.03   | (90)                   |
| $fLA = Living area \div (4) = 0.3$   |                        |
|  | <u> </u>               |
| Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$<br>(92)m= 19.46 19.68 19.97 20.28 20.44 20.48 20.49 20.49 20.47 20.25 19.8 19.42  | (92)                   |
| (92)m=         19.46         19.68         19.97         20.28         20.44         20.48         20.49         20.47         20.25         19.8         19.42           Apply adjustment to the mean internal temperature from Table 4e, where appropriate | (32)                   |
| (93)m= 19.46 19.68 19.97 20.28 20.44 20.48 20.49 20.49 20.47 20.25 19.8 19.42  | (93)                   |
| 8. Space heating requirement   | ()                     |
| Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate   |                        |
| the utilisation factor for gains using Table 9a  |                        |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  |                        |
| Utilisation factor for gains, hm:  |                        |
| (94)m= 1 0.99 0.96 0.88 0.72 0.51 0.35 0.39 0.64 0.92 0.99 1   | (94)                   |
| Useful gains, hmGm , W = (94)m x (84)m   |                        |
| (95)m=         580.36         688.85         762.83         771.73         663.89         459.39         305.29         320.09         490.73         614.91         575.41         545.07   | (95)                   |
| Monthly average external temperature from Table 8  | (06)                   |
| (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2   | (96)                   |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ]<br>(97)m= 1234.65 1200.52 1090.98 908.27 695.47 462.4 305.53 320.54 502.97 768.41 1016.31 1225.06   | (97)                   |
| Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$  | (01)                   |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $   |                        |
| $Total per year (kWh/year) = Sum(98)_{15912} = 2134$   | .14 (98)               |
|  |                        |
|  | 15 (99)                |
| 9a. Energy requirements – Individual heating systems including micro-CHP)  |                        |
| Space heating:<br>Fraction of space heat from secondary/supplementary system   | (201)                  |
|  |                        |
|  |                        |
| Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$  |                        |
| Efficiency of main space heating system 1 93   | 4 (206)                |
| Efficiency of secondary/supplementary heating system, %  | (208)                  |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec k  | Vh/year                |
| Space heating requirement (calculated above)   |                        |
| 486.79         343.85         244.14         98.31         23.49         0         0         0         0         114.2         317.45         505.91   |                        |
| $(211)m = \{[(98)m \times (204)] \} \times 100 \div (206)$   | (211)                  |
| 521.19         368.14         261.39         105.26         25.15         0         0         0         0         122.27         339.88         541.66   |                        |
| Total (kWh/year) =Sum(211) <sub>15,1012</sub> = 228 <sup>2</sup>   | .95 <mark>(211)</mark> |

Space heating fuel (secondary), kWh/month

| = {[(98)m x (201)] } x 100 ÷ (208)   |   |   |             |                                      |                                     |          |   |                                     |
|--|---|---|-------------|--------------------------------------|-------------------------------------|----------|---|-------------------------------------|
|  | <u> </u>  |   |             |                                      |                                     |          |   |                                     |
| (215)m= 0 0 0 0 0  | 0 0   | ) 0   | 0           | 0                                    | 0                                   | 0        |   |                                     |
|  |   | Tota  | l (kWh/yea  | ar) =Sum(2                           | 215) <sub>15,1012</sub>             | _=       | 0   | (21                                 |
| Water heating  |   |   |             |                                      |                                     |          |   |                                     |
| Output from water heater (calculated above)  |   |   |             |                                      |                                     |          | -   |                                     |
| 209.79 184.94 193.96 172.03 166.56 1   | 146.69 140  | .54 156.67                                  | 158.4       | 180.37                               | 190.96                              | 204.78   |   |                                     |
| Efficiency of water heater   |   |   |             |                                      |                                     |          | 80.3  | (21                                 |
| (217)m= 87.1 86.59 85.63 83.7 81.42  | 80.3 80   | .3 80.3                                     | 80.3        | 83.94                                | 86.32                               | 87.24    |   | (21                                 |
| Fuel for water heating, kWh/month  | -   |   | -           |                                      |                                     | -        | -   |                                     |
| $(219)m = (64)m \times 100 \div (217)m$  |   |   |             |                                      |                                     |          | 1   |                                     |
| (219)m= 240.86 213.58 226.5 205.53 204.55 1  | 182.68 175  |   | 197.26      | 214.89                               | 221.22                              | 234.73   |   | <b>-</b> 1.                         |
|  |   | TOTA  | al = Sum(2) |                                      |                                     |          | 2511.96   | (21                                 |
| Annual totals  |   |   |             | k                                    | Wh/year                             | r        | kWh/yea   | r<br>T                              |
| Space heating fuel used, main system 1   |   |   |             |                                      |                                     |          | 2284.95   |                                     |
| Water heating fuel used  |   |   |             |                                      |                                     |          | 2511.96   |                                     |
| Electricity for pumps, fans and electric keep-hot  |   |   |             |                                      |                                     |          |   |                                     |
| central heating pump:  |   |   |             |                                      |                                     | 30       |   | (23                                 |
| boiler with a fan-assisted flue  |   |   |             |                                      |                                     | 45       |   | (23                                 |
| Total electricity for the above, kWh/year  |   |   |             |                                      |                                     |          |   |                                     |
|  |   | sum   | of (230a).  | (230g) =                             |                                     |          | 75  | (23                                 |
|  |   | sum   | of (230a).  | (230g) =                             |                                     | _        | 75<br><b>3</b> 93.13  | (23                                 |
| Electricity for lighting   | ns including  |   |             | (230g) =                             |                                     |          |   |                                     |
|  | ns including  |   |             | (230g) =                             |                                     |          |   |                                     |
| Electricity for lighting   | Energy  | ) micro-CHF                                 |             | Emiss                                | ion fac                             | tor      | 393.13<br>Emission  | (23:                                |
| Electricity for lighting   |   | ) micro-CHF                                 |             |                                      | ion fac                             | tor      | 393.13  | (23:                                |
| Electricity for lighting<br>12a. CO2 emissions – Individual heating system   | Energy  | ) micro-CHF                                 |             | Emiss                                | <b>ion fac</b><br>2/kWh             | tor<br>= | 393.13<br>Emission  | (23:                                |
| Electricity for lighting<br>12a. CO2 emissions – Individual heating system<br>Space heating (main system 1)  | Energy<br>kWh/ye  | ) micro-CHF                                 |             | Emiss<br>kg CO                       | ion fac<br>2/kWh                    |          | 393.13<br>Emission<br>kg CO2/ye                                     | (23<br>s<br>ear                     |
| Electricity for lighting<br>12a. CO2 emissions – Individual heating system<br>Space heating (main system 1)<br>Space heating (secondary)   | Energy<br>kWh/ye  | ) micro-CHF                                 |             | Emiss<br>kg CO2                      | <b>ion fac</b><br>2/kWh<br>16       | =        | 393.13<br>Emission<br>kg CO2/ye<br>493.55                           | (23<br>s<br>ear<br>(26<br>(26       |
| Electricity for lighting<br>12a. CO2 emissions – Individual heating system<br>Space heating (main system 1)<br>Space heating (secondary)<br>Water heating                            | Energy<br>kWh/ye<br>(211) x<br>(215) x<br>(219) x               | ) micro-CHF                                 |             | Emiss<br>kg CO<br>0.2<br>0.5         | <b>ion fac</b><br>2/kWh<br>16       | =        | 393.13<br>Emission<br>kg CO2/ye<br>493.55<br>0                      | (23<br><b>s</b><br>ear<br>(26       |
| Electricity for lighting<br>12a. CO2 emissions – Individual heating system<br>Space heating (main system 1)<br>Space heating (secondary)<br>Water heating<br>Space and water heating | Energy<br>kWh/ye<br>(211) x<br>(215) x<br>(219) x               | 9 micro-CHF<br>9<br>262) + (263) + (        |             | Emiss<br>kg CO<br>0.2<br>0.5         | <b>ion fac</b><br>2/kWh<br>16<br>19 | =        | 393.13<br>Emission<br>kg CO2/ye<br>493.55<br>0<br>542.58            | (23<br>sear<br>(26<br>(26           |
| Electricity for lighting   | Energy<br>kWh/ye<br>(211) x<br>(215) x<br>(219) x<br>(261) + (2 | 2 miero-CHF<br>Y<br>2ar<br>262) + (263) + ( |             | Emiss<br>kg CO2<br>0.2<br>0.5<br>0.2 | ion fac<br>2/kWh<br>16<br>19<br>16  | -        | 393.13<br>Emission<br>kg CO2/ye<br>493.55<br>0<br>542.58<br>1036.13 | (23<br>s<br>ar<br>(26<br>(26<br>(26 |

TER =

13.81 (273)

|   |                               |                     | User D   | etails:                      |            |            |                       |           |                                     |                    |
|---|-------------------------------|---------------------|----------|------------------------------|------------|------------|-----------------------|-----------|-------------------------------------|--------------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 201               |                     |          | Stroma<br>Softwa<br>Address: | re Ver     |            |                       | Versio    | n: 1.0.4.23                         |                    |
| Address :   | 2 Bed Flat, 219-223           |                     |          |                              |            | ah Junct   | tion. LON             | NDON      |                                     |                    |
| 1. Overall dwelling dimer   |                               |                     |          | ,                            |            | ,          | ,                     |           |                                     |                    |
| Ground floor  |                               |                     | Area     |                              | (1a) x     | <b></b>    | <b>ight(m)</b><br>2.5 | (2a) =    | <b>Volume(m</b> <sup>3</sup><br>192 | 3 <b>)</b><br>(3a) |
| Total floor area TFA = (1a  | )+(1b)+(1c)+(1d)+(1e          | e)+(1n)             | ) 7      | 76.8                         | (4)        |            |                       |           |                                     |                    |
| Dwelling volume   |                               |                     |          |                              | (3a)+(3b)  | +(3c)+(3c  | d)+(3e)+              | .(3n) =   | 192                                 | (5)                |
| 2. Ventilation rate:  |                               |                     |          |                              |            |            |                       |           |                                     |                    |
| Number of chimneys  | main se<br>heating h          | econdary<br>leating | / · ·    | other<br>0                   | ] = [      | total<br>0 | x 4                   | 40 =      | m <sup>3</sup> per hou              | (6a)               |
| Number of open flues  | 0 +                           | 0                   | +        | 0                            | ] = [      | 0          | x2                    | 20 =      | 0                                   | (6b)               |
| Number of intermittent fan  | s                             |                     |          |                              | , L        | 3          | <b>x</b> 7            | 10 =      | 30                                  | (7a)               |
| Number of passive vents   |                               |                     |          |                              | Ē          | 0          | x ·                   | 10 =      | 0                                   | (7b)               |
| Number of flueless gas fire   | es                            |                     |          |                              |            | 0          | X 4                   | 40 =      | 0                                   | (7c)               |
|   |                               |                     |          |                              |            |            |                       | Air ch    | anges per ho                        | our                |
| Infiltration due to chimney   |                               |                     |          |                              |            | 30         |                       | ÷ (5) =   | 0.16                                | (8)                |
| <i>If a pressurisation test has be</i><br>Number of storeys in the<br>Additional infiltration | e dw <mark>elling</mark> (ns) |                     |          |                              |            |            |                       | -1]x0.1 = | 0                                   | (9)<br>(10)        |
| Structural infiltration: 0.2<br>if both types of wall are pre<br>deducting areas of opening   | sent, use the value corres    |                     |          |                              | •          | uction     |                       |           | 0                                   | (11)               |
| If suspended wooden flo   | oor, enter 0.2 (unseal        | ed) or 0.′          | 1 (seale | d), else                     | enter 0    |            |                       |           | 0                                   | (12)               |
| If no draught lobby, ente   |                               |                     |          |                              |            |            |                       |           | 0                                   | (13)               |
| Percentage of windows   | and doors draught st          | ripped              |          | 0.05 K0.0                    |            | 0.01       |                       |           | 0                                   | (14)               |
| Window infiltration   |                               |                     |          | 0.25 - [0.2                  |            |            | . (45)                | ·         | 0                                   | (15)               |
| Infiltration rate   | EQ overegoed in out           | io motros           |          | (8) + (10) -                 |            | · · · ·    |                       | oroo      | 0                                   | (16)               |
| Air permeability value, of<br>If based on air permeabilit                                     | • •                           |                     | •        | •                            |            |            | invelope              | alea      | 5                                   | (17)<br>(18)       |
| Air permeability value applies  | •                             |                     |          |                              |            | is being u | sed                   |           | 0.41                                | (10)               |
| Number of sides sheltered   |                               |                     | 0        |                              |            | Ū          |                       |           | 1                                   | (19)               |
| Shelter factor  |                               |                     |          | (20) = 1 - [                 | 0.075 x (1 | 9)] =      |                       |           | 0.92                                | (20)               |
| Infiltration rate incorporation   | ng shelter factor             |                     |          | (21) = (18)                  | x (20) =   |            |                       |           | 0.38                                | (21)               |
| Infiltration rate modified fo   | r monthly wind speed          | 1                   |          |                              |            |            |                       |           | L                                   |                    |
| Jan Feb M   | Mar Apr May                   | Jun                 | Jul      | Aug                          | Sep        | Oct        | Nov                   | Dec       |                                     |                    |
| Monthly average wind spe  | ed from Table 7               |                     |          |                              |            |            |                       |           |                                     |                    |
| (22)m= 5.1 5 4  | 4.4 4.3                       | 3.8                 | 3.8      | 3.7                          | 4          | 4.3        | 4.5                   | 4.7       |                                     |                    |
| Wind Factor (22a)m = (22)   | )m ÷ 4                        | r                   |          | ·                            |            |            |                       |           |                                     |                    |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08                  | 0.95                | 0.95     | 0.92                         | 1          | 1.08       | 1.12                  | 1.18      |                                     |                    |

| Adjust  | ed infiltra                  | ation rat      | e (allow          | ing for sh                  | nelter an         | nd wind s      | speed) =          | : (21a) x     | (22a)m               |                     |               |           | _        |                |
|---------|------------------------------|----------------|-------------------|-----------------------------|-------------------|----------------|-------------------|---------------|----------------------|---------------------|---------------|-----------|----------|----------------|
|         | 0.48                         | 0.47           | 0.46              | 0.41                        | 0.4               | 0.36           | 0.36              | 0.35          | 0.38                 | 0.4                 | 0.42          | 0.44      |          |                |
|         | <i>ate effec</i><br>echanica |                | -                 | rate for t                  | he appli          | cable ca       | se                |               |                      |                     |               |           |          | (220)          |
|         |                              |                |                   | endix N, (2                 | 3b) = (23;        | a) x Emv (e    | equation (        | N5)) othe     | rwise (23h           | (23a) = (23a)       |               |           | 0        | (23a)          |
|         |                              | • •            | 0 11              | ciency in %                 | , ,               | , (            | • •               | <i>,,</i> .   | ,                    | (_000)              |               |           | 0        | (23b)<br>(23c) |
|         |                              |                | -                 | entilation                  | -                 |                |                   |               |                      | 2h)m + (            | 23h) 🗸 [      | 1 – (23c) | -        | (230)          |
| (24a)m= |                              | 0              |                   |                             | 0                 |                |                   |               |                      |                     |               |           | ]        | (24a)          |
|         | balance                      | d mech         | ı<br>anical ve    | I<br>entilation             | without           | I<br>heat red  | L<br>Coverv (I    | 1<br>MV) (24b | (22)                 | 1<br>2b)m + (;      | 1<br>23b)     |           | I        |                |
| (24b)m= | 0                            | 0              | 0                 | 0                           | 0                 | 0              | 0                 | 0             | 0                    | 0                   | 0             | 0         | ]        | (24b)          |
| c) If   | whole h                      | ouse ex        | tract ver         | ntilation of                | or positiv        | /e input v     | ventilatio        | on from o     | outside              | I                   |               | I         | 1        |                |
| ,       |                              |                |                   | then (24d                   | •                 | •              |                   |               |                      | .5 × (23b           | )             |           |          |                |
| (24c)m= | 0                            | 0              | 0                 | 0                           | 0                 | 0              | 0                 | 0             | 0                    | 0                   | 0             | 0         | ]        | (24c)          |
| ,       |                              |                |                   | ole hous                    |                   | •              |                   |               |                      | o <b>-1</b>         |               |           |          |                |
|         | <u> </u>                     |                | <u> </u>          | )m = (22t                   |                   | <u>``</u>      | <u> </u>          | 1             | <u> </u>             | <u> </u>            | 0.50          |           | 1        | (244)          |
| (24d)m= | 0.61                         | 0.61           | 0.61              | 0.59                        | 0.58              | 0.56           | 0.56              | 0.56          | 0.57                 | 0.58                | 0.59          | 0.6       |          | (24d)          |
|         | ctive air                    | change<br>0.61 | rate - er<br>0.61 | nter (24a                   | ) or (241<br>0.58 | o) or (24      | c) or (24<br>0.56 | (d) in box    | x (25)               | 0.58                | 0.59          | 0.6       | 1        | (25)           |
| (25)m=  | 0.01                         | 0.01           | 0.01              | 0.59                        | 0.56              | 0.56           | 0.56              | -0.56         | 0.57                 | 0.56                | 0.59          | 0.6       |          | (23)           |
| 3. He   | at l <mark>osse</mark>       | s and he       | eat loss          | paramete                    | er:               |                |                   |               |                      |                     |               |           | _        |                |
| ELEN    |                              | Gros<br>area   |                   | Openin<br>m                 |                   | Net Ar<br>A ,r |                   | U-val<br>W/m2 |                      | A X U<br>(W/I       |               | k-value   |          | A X k<br>kJ/K  |
| Windo   | ws Type                      |                | ()                |                             |                   | 2.7            |                   | /[1/( 1.4 )+  |                      | 3.58                |               | 10,111    |          | (27)           |
|         | ws Type                      |                |                   |                             |                   | 3.6            |                   | /[1/( 1.4 )+  |                      | 4.77                | Ħ             |           |          | (27)           |
|         | ws Type                      |                |                   |                             |                   | 7.2            |                   | /[1/( 1.4 )+  |                      | 9.55                | Ħ             |           |          | (27)           |
|         | ws Type                      |                |                   |                             |                   | 4.94           |                   | /[1/( 1.4 )+  |                      | 6.55                | H             |           |          | (27)           |
| Walls   |                              | 5              |                   | 2.7                         |                   | 2.3            |                   | 0.18          |                      | 0.33                |               |           |          | (29)           |
| Walls   |                              | 31.            |                   | 3.6                         |                   | 27.9           |                   | 0.18          |                      | 5.02                |               |           | $\dashv$ | (29)           |
| Walls   |                              | 22.7           |                   |                             |                   | 15.55          |                   |               |                      |                     |               |           | $\dashv$ | (29)           |
| Walls   |                              | 15             |                   | 4.94                        |                   | 10.06          |                   | 0.18          |                      | 2.8<br>1.81         |               |           | $\dashv$ | (29)           |
|         | rea of e                     |                |                   | 4.94                        |                   |                |                   | 0.10          |                      | 1.01                | L             |           |          | (31)           |
| Party   |                              | lementa        | ,                 |                             |                   | 74.25          |                   |               |                      | 0                   | r             |           |          |                |
| Party f |                              |                |                   |                             |                   | 37.5           | ×                 | 0             | =                    | 0                   |               |           | $\dashv$ | (32)           |
|         |                              |                |                   |                             |                   | 76.8           |                   |               |                      |                     | L             |           | $\dashv$ | (32a)          |
| Party o | al wall **                   |                |                   |                             |                   | 76.8           |                   |               |                      |                     | l             |           | $\dashv$ | (32b)          |
|         |                              | roofwind       |                   | footivowi                   | ndowilly          | 117            |                   | n farmula 1   | 11/1/11              | (0) (0) (1)         |               | norogrank |          | (32c)          |
|         |                              |                | sides of i        | effective wi<br>nternal wal |                   |                | ลเฮน นรที่ได้     | g iomula l    | /( // <b>U</b> -vall | <i>i⊖)</i> +0.04] a | is yiveri Ili | ραιαγιαρί | 1 J.Z    |                |
|         |                              |                |                   | normal mai                  | o una par         |                |                   |               |                      |                     |               |           |          |                |
| Fabric  |                              |                | = S (A x          |                             | o ana par         |                |                   | (26)(30)      | ) + (32) =           |                     |               |           | 34.49    | ) (33)         |

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

| 4 78 (36) |
|-----------|
|-----------|

250

Indicative Value: Medium

(35)

| if detail | s of therma | al bridging         | are not kr  | 10wn (36) =                | = 0.05 x (3    | 1)          |            |                   |                       |   |                        |         |         | _        |
|-----------|-------------|---------------------|-------------|----------------------------|----------------|-------------|------------|-------------------|-----------------------|---|------------------------|---------|---------|----------|
| Total f   | abric he    | at loss             |             |                            |                |             |            |                   | (33) +                | (36) =                                  |                        |         | 39.27   | (37)     |
| Ventila   | ation hea   | at loss ca          | alculated   | monthl                     | y              | -           | -          |                   | (38)m                 | = 0.33 × (                              | 25)m x (5)             | )       |         |          |
|           | Jan         | Feb                 | Mar         | Apr                        | May            | Jun         | Jul        | Aug               | Sep                   | Oct                                     | Nov                    | Dec     |         |          |
| (38)m=    | 38.95       | 38.67               | 38.39       | 37.09                      | 36.85          | 35.72       | 35.72      | 35.51             | 36.15                 | 36.85                                   | 37.34                  | 37.86   |         | (38)     |
| Heat t    | ransfer o   | coefficie           | nt, W/K     |                            |                |             |            |                   | (39)m                 | = (37) + (3                             | 38)m                   |         |         |          |
| (39)m=    | 78.23       | 77.94               | 77.67       | 76.37                      | 76.12          | 74.99       | 74.99      | 74.78             | 75.43                 | 76.12                                   | 76.62                  | 77.13   |         |          |
| Heat I    | oss para    | Imeter (H           | HLP), W     | /m²K                       |                | •           |            | •                 |                       | Average =<br>= (39)m ÷                  |                        | 12 /12= | 76.37   | (39)     |
| (40)m=    | 1.02        | 1.01                | 1.01        | 0.99                       | 0.99           | 0.98        | 0.98       | 0.97              | 0.98                  | 0.99                                    | 1                      | 1       |         |          |
|           |             | 1                   | 1           |                            |                | 1           | 1          |                   |                       | Average =                               | Sum(40)₁               | 12 /12= | 0.99    | (40)     |
| Numb      | er of day   | /s in mo            | nth (Tab    | le 1a)                     |                | -           | -          |                   |                       | -                                       |                        |         |         |          |
|           | Jan         | Feb                 | Mar         | Apr                        | May            | Jun         | Jul        | Aug               | Sep                   | Oct                                     | Nov                    | Dec     |         |          |
| (41)m=    | 31          | 28                  | 31          | 30                         | 31             | 30          | 31         | 31                | 30                    | 31                                      | 30                     | 31      |         | (41)     |
|           |             |                     |             |                            |                |             |            |                   |                       |   |                        |         |         |          |
| 4. W      | ater hea    | ting ene            | rgy requ    | irement:                   |                |             |            |                   |                       |   |                        | kWh/ye  | ear:    |          |
|           |             |                     |             |                            |                |             |            |                   |                       |   |                        |         | 1       |          |
|           |             | upancy,∣<br>o N – 1 |             | 1 - evn                    | (_0 0003       |             | -130       | )2)] + 0.0        | )013 x ( <sup>-</sup> | TFA -13                                 |                        | 4       |         | (42)     |
|           | A £ 13.     |                     | + 1.70 ×    | . [1 - exp                 | (-0.000        | ,43 x (11   | A -13.3    | )2)] + 0.0        |                       | II A -13.                               | .3)                    |         |         |          |
|           |             |                     |             |                            |                |             |            | (25 x N)          |                       |   |                        | .18     |         | (43)     |
|           |             | -                   |             | usage by a<br>r day (all w |                | -           | -          | to achieve        | a water us            | se target o                             | f                      |         |         |          |
| notmoi    |             |                     |             |                            |                |             |            |                   |                       |   |                        |         |         |          |
| 11-4      | Jan         | Feb                 | Mar         | Apr                        | May            | Jun         | Jul        | Aug               | Sep                   | Oct                                     | Nov                    | Dec     |         |          |
|           |             |                     |             | ach month                  |                |             |            |                   |                       |   |                        | i       |         |          |
| (44)m=    | 100.3       | 96.66               | 93.01       | 89.36                      | 85.71          | 82.07       | 82.07      | 85.71             | 89.36                 | 93.01                                   | 96.66                  | 100.3   |         | <b>-</b> |
| Energy    | content of  | hot water           | used - cai  | culated mo                 | onthly $= 4$ . | 190 x Vd,r  | m x nm x D | 0Tm / 3600        |                       | Tota <mark>l = Su</mark><br>hth (see Ta | · · ·                  |         | 1094.21 | (44)     |
| (45)m=    | 148.75      | 130.09              | 134.25      | 117.04                     | 112.3          | 96.91       | 89.8       | 103.05            | 104.28                | 121.52                                  | 132.65                 | 144.05  |         |          |
|           |             |                     |             | •                          |                |             |            | •                 |                       | Total = Su                              | m(45) <sub>112</sub> = | =       | 1434.68 | (45)     |
| lf instar | taneous v   | ater heati          | ng at point | t of use (no               | hot water      | r storage), | enter 0 in | boxes (46,        | ) to (61)             | -                                       | -                      |         |         |          |
| (46)m=    | 22.31       | 19.51               | 20.14       | 17.56                      | 16.85          | 14.54       | 13.47      | 15.46             | 15.64                 | 18.23                                   | 19.9                   | 21.61   |         | (46)     |
|           | storage     |                     | includir    |                            | olor or M      |             | otorogo    | within or         |                       | aal                                     |                        | -       | 1       | (47)     |
| -         |             | . ,                 |             |                            |                |             | -          | within sa         | ame ves               | 501                                     |                        | 0       |         | (47)     |
|           | •           | •                   |             | ank in dw<br>ar (this in   | •              |             |            | (47)<br>ombi boil | ore) onte             | ər '()' in (                            | 47)                    |         |         |          |
|           | storage     |                     | not wate    |                            | iciuues i      | nstantai    |            |                   |                       |   | <i><b>H</b>()</i>      |         |         |          |
|           | -           |                     | eclared I   | oss facto                  | or is kno      | wn (kWł     | n/day):    |                   |                       |   |                        | 0       |         | (48)     |
| Temp      | erature f   | actor fro           | m Table     | 2b                         |                |             | • •        |                   |                       |   |                        | 0       |         | (49)     |
|           |             |                     |             | , kWh/y∉                   | ear            |             |            | (48) x (49)       | =                     |   |                        | 0       |         | (50)     |
| -         | -           |                     | -           | cylinder l                 |                | or is not   |            | . , . ,           |                       |   |                        | 0       |         | (00)     |
| Hot wa    | ater stor   | age loss            | factor fi   | rom Tabl                   | e 2 (kW        | h/litre/da  | ay)        |                   |                       |   |                        | 0       |         | (51)     |
|           | •           | neating s           |             | on 4.3                     |                |             |            |                   |                       |   |                        |         |         |          |
|           |             | from Ta             |             | Oh                         |                |             |            |                   |                       |   |                        | 0       |         | (52)     |
|           |             | actor fro           |             |                            |                |             |            |                   |                       |   |                        | 0       |         | (53)     |
| -         | -           |                     | -           | e, kWh/ye                  | ear            |             |            | (47) x (51)       | x (52) x (            | 53) =                                   |                        | 0       |         | (54)     |
| Enter     | (50) or     | (54) in (5          | 5)          |                            |                |             |            |                   |                       |   |                        | 0       |         | (55)     |

| Water                | storage    | loss cal   | culated     | for each   | month      |                        |                          | ((56)m = (   | 55) × (41)   | m                          |             |                        |               |      |
|----------------------|------------|------------|-------------|------------|------------|------------------------|--------------------------|--------------|--------------|----------------------------|-------------|------------------------|---------------|------|
| (56)m=               | 0          | 0          | 0           | 0          | 0          | 0                      | 0                        | 0            | 0            | 0                          | 0           | 0                      |               | (56) |
| If cylind            | er contain | s dedicate | d solar sto | rage, (57) | m = (56)m  | x [(50) – (            | H11)] ÷ (5               | 0), else (5  | 7)m = (56)   | m where (                  | H11) is fro | m Append               | lix H         |      |
| (57)m=               | 0          | 0          | 0           | 0          | 0          | 0                      | 0                        | 0            | 0            | 0                          | 0           | 0                      |               | (57) |
| Primar               | y circuit  | loss (ar   | nual) fro   | om Table   | e 3        |                        |                          |              |              |                            |             | 0                      |               | (58) |
| Primar               | y circuit  | loss cal   | culated     | for each   | month (    | 59)m = (               | (58) ÷ 36                | 65 × (41)    | m            |                            |             |                        |               |      |
| (mo                  | dified by  | factor f   | rom Tab     | le H5 if t | here is s  | solar wat              | ter heatii               | ng and a     | cylinde      | r thermo                   | stat)       |                        |               |      |
| (59)m=               | 0          | 0          | 0           | 0          | 0          | 0                      | 0                        | 0            | 0            | 0                          | 0           | 0                      |               | (59) |
| Combi                | loss ca    | lculated   | for each    | month      | (61)m =    | (60) ÷ 36              | 65 × (41)                | )m           |              |                            |             |                        |               |      |
| (61)m=               | 50.96      | 44.49      | 47.4        | 44.07      | 43.68      | 40.47                  | 41.82                    | 43.68        | 44.07        | 47.4                       | 47.67       | 50.96                  |               | (61) |
| Total h              | neat req   | uired for  | water h     | eating ca  | alculated  | for eac                | h month                  | (62)m =      | 0.85 ×       | (45)m +                    | (46)m +     | (57)m +                | (59)m + (61)m | Ì    |
| (62)m=               | 199.71     | 174.58     | 181.64      | 161.11     | 155.98     | 137.38                 | 131.62                   | 146.72       | 148.34       | 168.92                     | 180.32      | 195.01                 |               | (62) |
| Solar DI             | -IW input  | calculated | using App   | endix G o  | r Appendix | H (negati              | ve quantity              | /) (enter '0 | ' if no sola | r contribut                | ion to wate | er heating)            |               |      |
| (add a               | dditiona   | l lines if | FGHRS       | and/or \   | NWHRS      | applies                | , see Ap                 | pendix (     | G)           |                            | -           | -                      |               |      |
| (63)m=               | 0          | 0          | 0           | 0          | 0          | 0                      | 0                        | 0            | 0            | 0                          | 0           | 0                      |               | (63) |
| Output               | t from w   | ater hea   | ter         |            |            |                        |                          |              |              |                            |             |                        |               |      |
| (64)m=               | 199.71     | 174.58     | 181.64      | 161.11     | 155.98     | 137.38                 | 131.62                   | 146.72       | 148.34       | 168.92                     | 180.32      | 195.01                 |               | _    |
|                      |            |            |             |            |            |                        |                          | Outp         | out from w   | ater heate                 | r (annual)₁ | 12                     | 1981.33       | (64) |
| Hea <mark>t g</mark> | ains fro   | m water    | heating     | , kWh/m    | onth 0.2   | <mark>5 ´</mark> [0.85 | × (45)m                  | + (61)n      | n] + 0.8 x   | k [( <mark>46)m</mark>     | + (57)m     | + (59)m                | ]             |      |
| (65)m=               | 62.2       | 54.38      | 56.49       | 49.93      | 48.26      | 42.34                  | 40.31                    | 45.18        | 45.69        | 52.26                      | 56.02       | 60.64                  |               | (65) |
| inclu                | ide (57)   | m in calo  | culation    | of (65)m   | only if c  | ylinder i              | s in t <mark>he</mark> o | dwelling     | or hot w     | rate <mark>r is f</mark> r | om com      | <mark>mu</mark> nity h | eating        |      |
| 5. In                | ternal ga  | ains (see  | e Table 8   | 5 and 5a   | ):         |                        |                          |              |              |                            |             |                        |               |      |
| Metab                | olic gair  | s (Table   | 5), Wat     | ts         |            |                        |                          |              |              |                            |             |                        |               |      |
|                      | Jan        | Feb        | Mar         | Apr        | May        | Jun                    | Jul                      | Aug          | Sep          | Oct                        | Nov         | Dec                    |               |      |
| (66)m=               | 119.97     | 119.97     | 119.97      | 119.97     | 119.97     | 119.97                 | 119.97                   | 119.97       | 119.97       | 119.97                     | 119.97      | 119.97                 |               | (66) |
| Lightin              | g gains    | (calcula   | ted in A    | opendix    | L, equat   | ion L9 o               | r L9a), a                | lso see      | Table 5      |                            |             |                        |               |      |
| (67)m=               | 18.96      | 16.84      | 13.69       | 10.37      | 7.75       | 6.54                   | 7.07                     | 9.19         | 12.33        | 15.66                      | 18.28       | 19.48                  |               | (67) |
| Applia               | nces ga    | ins (calc  | ulated ir   | Append     | dix L, eq  | uation L               | 13 or L1                 | 3a), also    | see Ta       | ble 5                      | _           | _                      |               |      |
| (68)m=               | 212.62     | 214.83     | 209.27      | 197.43     | 182.49     | 168.45                 | 159.07                   | 156.86       | 162.42       | 174.26                     | 189.2       | 203.24                 |               | (68) |
| Cookir               | ng gains   | (calcula   | ted in A    | ppendix    | L, equat   | tion L15               | or L15a)                 | ), also se   | e Table      | 5                          |             |                        | _             |      |
| (69)m=               | 35         | 35         | 35          | 35         | 35         | 35                     | 35                       | 35           | 35           | 35                         | 35          | 35                     |               | (69) |
| Pumps                | s and fai  | ns gains   | (Table :    | 5a)        |            |                        |                          |              |              |                            |             |                        | -             |      |
| (70)m=               | 3          | 3          | 3           | 3          | 3          | 3                      | 3                        | 3            | 3            | 3                          | 3           | 3                      |               | (70) |
| Losse                | s e.g. ev  | aporatio   | n (nega     | tive valu  | es) (Tab   | ole 5)                 |                          |              |              |                            |             |                        |               |      |
| (71)m=               | -95.97     | -95.97     | -95.97      | -95.97     | -95.97     | -95.97                 | -95.97                   | -95.97       | -95.97       | -95.97                     | -95.97      | -95.97                 |               | (71) |
| Water                | heating    | gains (T   | able 5)     |            |            |                        |                          |              |              |                            |             |                        | -             |      |
| (72)m=               | 83.6       | 80.92      | 75.92       | 69.35      | 64.87      | 58.8                   | 54.18                    | 60.73        | 63.46        | 70.24                      | 77.81       | 81.5                   |               | (72) |
| Total i              | nternal    | gains =    |             |            |            | (66)                   | m + (67)m                | n + (68)m +  | + (69)m +    | (70)m + (7                 | 1)m + (72)  | m                      | -             |      |
|                      |            | guino -    |             |            |            |                        |                          | 1 C C        | · · ·        |                            | · · · ·     |                        |               |      |
| (73)m=               | 377.17     | 374.58     | 360.87      | 339.14     | 317.1      | 295.79                 | 282.31                   | 288.77       | 300.2        | 322.14                     | 347.27      | 366.22                 |               | (73) |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation:   | Access Factor<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a     |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|----------------|---------------------------|---|------------|---|----------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 11.28                | x | 0.63           | x | 0.7            | = | 12.41        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 22.97                | x | 0.63           | x | 0.7            | = | 25.27        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 41.38                | x | 0.63           | x | 0.7            | = | 45.53        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 67.96                | x | 0.63           | x | 0.7            | = | 74.77        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 91.35                | x | 0.63           | x | 0.7            | = | 100.5        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 97.38                | x | 0.63           | x | 0.7            | = | 107.14       | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 91.1                 | x | 0.63           | x | 0.7            | = | 100.23       | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 72.63                | x | 0.63           | x | 0.7            | = | 79.9         | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 50.42                | x | 0.63           | x | 0.7            | = | 55.47        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 28.07                | x | 0.63           | x | 0.7            | = | 30.88        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 14.2                 | x | 0.63           | x | 0.7            | = | 15.62        | (75) |
| Northeast 0.9x | 0.77                      | x | 3.6        | x | 9.21                 | x | 0.63           | x | 0.7            | = | 10.14        | (75) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 36.79                | ] | 0.63           | x | 0.7            | = | 30.36        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 62.67                | ] | 0.63           | x | 0.7            | = | 51.72        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 85.75                | ] | 0.63           | x | 0.7            | = | 70.76        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | × | 106.25               |   | 0.63           | x | 0.7            | = | 87.67        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 119.01               |   | 0.63           | x | 0.7            | = | 98.2         | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 118.15               |   | 0.63           | x | 0.7            | = | 97.49        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 113.91               |   | 0.63           | x | 0.7            | = | 93.99        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 104.3 <mark>9</mark> | ] | 0.63           | x | 0.7            | = | 86.14        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 92.85                |   | 0.63           | x | 0.7            | = | 76.62        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 69.27                | ] | 0.63           | x | 0.7            | = | 57.16        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 44.07                | ] | 0.63           | x | 0.7            | = | 36.37        | (79) |
| Southwest0.9x  | 0.77                      | x | 2.7        | x | 31.49                | ] | 0.63           | x | 0.7            | = | 25.98        | (79) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 19.64                | x | 0.63           | x | 0.7            | = | 29.65        | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 38.42                | × | 0.63           | x | 0.7            | = | 58           | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 63.27                | x | 0.63           | x | 0.7            | = | 95.53        | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 92.28                | × | 0.63           | x | 0.7            | = | 139.32       | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 113.09               | × | 0.63           | x | 0.7            | = | 170.74       | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 115.77               | x | 0.63           | x | 0.7            | = | 174.78       | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 110.22               | x | 0.63           | x | 0.7            | = | 166.4        | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 94.68                | × | 0.63           | x | 0.7            | = | 142.93       | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 73.59                | × | 0.63           | x | 0.7            | = | 111.1        | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 45.59                | × | 0.63           | x | 0.7            | = | 68.83        | (80) |
| West 0.9x      | 0.77                      | x | 4.94       | x | 24.49                | x | 0.63           | x | 0.7            | = | 36.97        | (80) |
| West 0.9x      |                           | x | 4.94       | x | 16.15                | x | 0.63           | x | 0.7            | = | 24.38        | (80) |
| Northwest 0.9x |                           | x | 7.2        | x | 11.28                | × | 0.63           | x | 0.7            | = | 24.83        | (81) |
| Northwest 0.9x |                           | x | 7.2        | x | 22.97                | × | 0.63           | x | 0.7            | = | 50.54        | (81) |
| Northwest 0.9x | 0.77                      | x | 7.2        | x | 41.38                | × | 0.63           | x | 0.7            | = | 91.05        | (81) |

| Northwest  |                   |              |           |           |            | 1 F            |              | — –         |             |           |        | <b>-</b> |
|--|-------------------|--------------|-----------|-----------|------------|----------------|--------------|-------------|-------------|-----------|--------|----------|
| Northwest 0.9x 0.77  | ×                 | 7.2          |           | ×         | 67.96      |                | 0.63         |             | 0.7         | =         | 149.53 | (81)     |
| Northwest 0.9x 0.77  | ×                 | 7.2          |           | x         | 91.35      | Ĭ×Ĺ            | 0.63         |             | 0.7         | =         | 201    | (81)     |
| Northwest 0.9x 0.77  | ×                 | 7.2          |           | x         | 97.38      | X              | 0.63         | × [         | 0.7         | =         | 214.29 | (81)     |
| Northwest 0.9x 0.77  | ×                 | 7.2          |           | ×         | 91.1       | ×              | 0.63         | × [         | 0.7         | =         | 200.46 | (81)     |
| Northwest 0.9x 0.77  | x                 | 7.2          |           | x         | 72.63      | ×              | 0.63         | ×           | 0.7         | =         | 159.81 | (81)     |
| Northwest 0.9x 0.77  | ×                 | 7.2          |           | × !       | 50.42      | ×              | 0.63         | ×           | 0.7         | =         | 110.95 | (81)     |
| Northwest 0.9x 0.77  | x                 | 7.2          |           | x         | 28.07      | ] × [          | 0.63         | x           | 0.7         | =         | 61.76  | (81)     |
| Northwest 0.9x 0.77  | x                 | 7.2          |           | x         | 14.2       | ] × [          | 0.63         | x           | 0.7         | =         | 31.24  | (81)     |
| Northwest 0.9x 0.77  | x                 | 7.2          |           | x         | 9.21       | ] × [          | 0.63         | x           | 0.7         | =         | 20.28  | (81)     |
|  |                   |              |           |           |            |                |              |             |             |           |        |          |
| Solar gains in watts, calc   | ulated            | for each     | month     |           |            | (83)m          | = Sum(74)m   | (82)m       |             |           |        |          |
| (83)m= 97.25 185.52 3  | 302.86            | 451.29       | 570.44    | 593.7     | 561.08     | 468.           | 79 354.14    | 218.62      | 120.2       | 80.78     |        | (83)     |
| Total gains – internal and   | d solar           | (84)m = (    | (73)m +   | + (83)m   | , watts    |                |              | i           |             |           | L      |          |
| (84)m= 474.42 560.1 6  | 63.73             | 790.43       | 887.54    | 889.49    | 843.39     | 757.           | 55 654.34    | 540.76      | 467.47      | 446.99    |        | (84)     |
| 7. Mean internal temper  | rature (          | heating s    | season)   | )         |            |                |              |             |             |           |        |          |
| Temperature during hea   | ating pe          | eriods in t  | the livin | ng area   | from Tal   | ole 9,         | Th1 (°C)     |             |             |           | 21     | (85)     |
| Utilisation factor for gair  | ns for li         | ving area    | a, h1,m   | (see Ta   | able 9a)   |                |              |             |             |           |        |          |
| Jan Feb  | Mar               | Apr          | May       | Jun       | Jul        | Au             | ig Sep       | Oct         | Nov         | Dec       |        |          |
| (86)m= 1 0.99  | 0.98              | 0.91         | 0.74      | 0.53      | 0.39       | 0.4            | 5 0.74       | 0.96        | 0.99        | 1         |        | (86)     |
| Mean internal temperat   | ure in li         | iving area   | a T1 (fo  | ollow ste | eps 3 to 7 | ,<br>7 in Ta   | able 9c)     |             |             | •         |        |          |
| (87)m= 19.96 20.12   | 20.4              |              | 20.94     | 20.99     | 21         | 21             |              | 20.66       | 20.25       | 19.93     |        | (87)     |
|  |                   |              |           | -h        |            |                |              |             |             |           |        |          |
| Temperature during heat           (88)m=         20.07         20.07           | 20.07             |              | 20.09     | 20.1      | 20.1       | 20.1           |              | 20.09       | 20.09       | 20.08     |        | (88)     |
|  |                   |              |           |           |            |                | 20.1         | 20.00       | 20.00       | 20.00     |        | (00)     |
| Utilisation factor for gain  | î                 |              | <u> </u>  |           | 1          | <del>r ´</del> |              |             |             |           |        | (00)     |
| (89)m= 1 0.99  | 0.97              | 0.88         | 0.68      | 0.46      | 0.31       | 0.37           | 7 0.66       | 0.94        | 0.99        | 1         |        | (89)     |
| Mean internal temperat   | ure in t          | he rest of   | f dwelli  | ng T2 (f  | ollow ste  | eps 3          | to 7 in Tab  | le 9c)      |             | -         |        |          |
| (90)m= 18.67 18.92   | 19.32             | 19.8         | 20.03     | 20.1      | 20.1       | 20.7           |              | 19.7        | 19.11       | 18.65     |        | (90)     |
|  |                   |              |           |           |            |                |              | fLA = Livir | ng area ÷ ( | 4) =      | 0.34   | (91)     |
| Mean internal temperat   | ure (for          | the who      | le dwel   | ling) = f | LA × T1    | + (1 -         | - fLA) × T2  |             |             |           |        |          |
|  | 19.69             |              | 20.34     | 20.4      | 20.41      | 20.4           |              | 20.03       | 19.5        | 19.09     |        | (92)     |
| Apply adjustment to the  | mean              | internal t   | empera    | ature fro | m Table    | 4e, v          | where appr   | opriate     | •           |           |        |          |
| (93)m= 19.11 19.33   | 19.69             | 20.12        | 20.34     | 20.4      | 20.41      | 20.4           | 1 20.37      | 20.03       | 19.5        | 19.09     |        | (93)     |
| 8. Space heating requir  | ement             |              |           |           |            |                |              |             |             |           |        |          |
| Set Ti to the mean inter   |                   | •            |           | ed at st  | ep 11 of   | Table          | e 9b, so tha | at Ti,m=(   | (76)m an    | d re-calc | culate |          |
| the utilisation factor for   | <u> </u>          |              |           |           | 1          | <u> </u>       |              |             | 1           |           |        |          |
| Jan Feb  | Mar               | Apr          | May       | Jun       | Jul        | Au             | ig Sep       | Oct         | Nov         | Dec       |        |          |
| Utilisation factor for gain<br>(94)m= $\begin{bmatrix} 1 & 0.99 \end{bmatrix}$ |                   |              | 0.7       | 0.40      | 0.24       | 0.20           |              | 0.94        | 0.00        | 1         |        | (94)     |
| (94)m= 1 0.99<br>Useful gains, hmGm , V  | 0.97              | 0.88         | 0.7       | 0.49      | 0.34       | 0.39           | 9 0.69       | 0.94        | 0.99        | 1         |        | (34)     |
|  | v = (94<br>641.71 | <u>, , ,</u> | 621.82    | 431.55    | 285.3      | 299.0          | 01 449.73    | 509.2       | 463.08      | 445.62    |        | (95)     |
| Monthly average extern   |                   |              |           |           |            | L_00.          |              | 1 300.2     | 1.00.00     |           | l      | ()       |
| (96)m= 4.3 4.9   | 6.5               | 8.9          | 11.7      | 14.6      | 16.6       | 16.4           | 4 14.1       | 10.6        | 7.1         | 4.2       |        | (96)     |
| Heat loss rate for mean  |                   |              |           |           |            |                |              |             | I           | I         | l      |          |
|  | 024.47            | <u> </u>     | 657.88    | 435.25    | 285.68     | 299.8          |              | 717.61      | 949.8       | 1148.25   |        | (97)     |
|  |                   |              | -         |           |            | L              |              |             |             |           | I      |          |

|                         |                   |                     |                     |            |                  | En        | ergy     |                              |                        | Emiss                 | ion fac                         | tor    | Emissions | 6      |
|-------------------------|-------------------|---------------------|---------------------|------------|------------------|-----------|----------|------------------------------|------------------------|-----------------------|---------------------------------|--------|-----------|--------|
| 12a. C                  | O2 em             | issions ·           | – Individ           | lual heat  | ing syste        | ems inclu | uding mi | cro-CHP                      |                        |                       |                                 |        |           |        |
| Electrici               | ity for li        | ghting              |                     |            |                  |           |          |                              |                        |                       |                                 |        | 334.76    | (232)  |
|                         | -                 |                     | above,              | kWh/yea    | ır               |           |          | sum                          | of (230a).             | (230g) =              |                                 |        | 75        | (231)  |
|                         |                   |                     | sted flue           |            |                  |           |          |                              |                        |                       |                                 | 45     |           | (230e) |
|                         |                   | g pump              |                     |            |                  |           |          |                              |                        |                       |                                 | 30     |           | (230c) |
|                         |                   | •                   |                     | electric   | keep-ho          | t         |          |                              |                        |                       |                                 |        | I         |        |
|                         | -                 | fuel use            |                     |            |                  |           |          |                              |                        |                       |                                 |        | 2355.22   |        |
| •                       | 0                 |                     |                     | system     | 1                |           |          |                              |                        |                       |                                 |        | 2514.99   |        |
| Annual                  |                   | f                   | ad maain            | o voto m   | 4                |           |          |                              |                        | k                     | Wh/year                         |        | kWh/yea   | r<br>J |
|                         |                   |                     |                     |            |                  |           |          | Tota                         | I = Sum(2 <sup>-</sup> | 19a) <sub>112</sub> = |                                 |        | 2355.22   | (219)  |
|                         | = (64)            | •                   | ) ÷ (217)<br>210.77 |            | 191.06           | 171.08    | 163.91   | 182.72                       | 184.74                 | 199.11                | 207.99                          | 223.09 |           | _      |
| i í L                   |                   |                     | kWh/m               |            | 01.04            | 00.5      | 00.5     | 00.0                         | 00.0                   | 04.04                 | 00.7                            | 07.41  |           | (217)  |
| г                       | 87.31             | ater hea<br>86.98   | 86.18               | 84.22      | 81.64            | 80.3      | 80.3     | 80.3                         | 80.3                   | 84.84                 | 86.7                            | 87.41  | 80.3      | (217)  |
| L                       |                   |                     | 181.64              | 161.11     | 155.98           | 137.38    | 131.62   | 146.72                       | 148.34                 | 168.92                | 180.32                          | 195.01 | 00.0      | (216)  |
|                         | from w            |                     |                     | ulated a   |                  | 127.29    | 121 62   | 146 70                       | 149.24                 | 169.02                | 190.22                          | 105.01 |           |        |
|                         |                   |                     |                     |            |                  |           |          | Tota                         | l (kWh/yea             | ar) =Sum(2            | 2 <b>15)</b> <sub>15,1012</sub> |        | 0         | (215)  |
|                         |                   | -                   | 00 ÷ (20            |            | 0                | 0         | 0        | 0                            | 0                      | 0                     | 0                               | 0      |           |        |
| Space                   | heatin            | g fuel (s           | econdar             | y), kWh/   | month            |           |          |                              |                        |                       |                                 |        |           |        |
| L                       |                   |                     |                     |            |                  |           |          | -                            | -                      | ar) =Sum(2            |                                 |        | 2514.99   | (211)  |
| · · ·                   | = {[(98<br>546.65 | )m x (20<br>410.59  | 304.9               | 100 ÷ (20  | 28.72            | 0         | 0        | 0                            | 0                      | 166.02                | 375.21                          | 559.7  |           | (211)  |
| L                       |                   |                     |                     |            |                  | 0         | 0        | 0                            | 0                      | 133.00                | 330.44                          | 322.10 |           | (014)  |
| · -                     | heatin<br>510.57  | g require<br>383.49 | ement (0<br>284.78  | alculate   | d above<br>26.82 | )         | 0        | 0                            | 0                      | 155.06                | 350.44                          | 522.76 |           |        |
| Ĺ                       | Jan               | Feb                 | Mar                 | Apr        | May              | Jun       | Jul      | Aug                          | Sep                    | Oct                   | Nov                             | Dec    | kWh/ye    | ear    |
| Efficier                | ncy of s          | seconda             | ry/suppl            | ementar    | y heatin         | g system  | n, %     |                              |                        |                       |                                 |        | 0         | (208)  |
|                         |                   |                     |                     | ting syste |                  |           |          |                              |                        |                       |                                 |        | 93.4      | (206)  |
| Fractic                 | on of to          | tal heati           | ng from             | main sys   | stem 1           |           |          | (204) = (2                   | 02) × [1 –             | (203)] =              |                                 |        | 1         | (204)  |
| Fractic                 | on of sp          | ace hea             | at from n           | nain syst  | em(s)            |           |          | (202) = 1 -                  | - (201) =              |                       |                                 |        | 1         | (202)  |
| <b>Space</b><br>Fractic |                   | -                   | at from s           | econdar    | y/supple         | mentary   | v system |                              |                        |                       |                                 |        | 0         | (201)  |
| 9a. Ene                 | rgy rec           | luiremer            | nts – Ind           | ividual h  | eating s         | ystems i  | ncluding | micro-C                      | CHP)                   |                       |                                 |        |           |        |
| Space                   | heatin            | g require           | ement in            | n kWh/m²   | ²/year           |           |          |                              |                        |                       | ,                               |        | 30.59     | (99)   |
| (50)11-                 | 010.07            | 505.45              | 204.70              | 110.00     | 20.02            | 0         | 0        |                              | -                      | (kWh/year             |                                 |        | 2349      | (98)   |
| · -                     | neatin<br>510.57  | 383.49              | 284.78              | 115.06     | 26.82            |           | n = 0.02 | $\frac{24 \times [(97)]}{0}$ | )m – (95<br>0          | 155.06                | 350.44                          | 522.76 |           |        |

Space heating requirement for each month k///h/month = 0.024 x [(97)m = (95)m] x (41)m

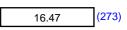
kWh/year

Emission factor kg CO2/kWh

Emissions kg CO2/year

| Space heating (main system 1)                     | (211) x                         | 0.216           | = | 543.24  | (261) |
|---|---------------------------------|-----------------|---|---------|-------|
| Space heating (secondary)                         | (215) x                         | 0.519           | = | 0       | (263) |
| Water heating                                     | (219) x                         | 0.216           | = | 508.73  | (264) |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                 |   | 1051.96 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519           | = | 38.93   | (267) |
| Electricity for lighting                          | (232) x                         | 0.519           | = | 173.74  | (268) |
| Total CO2, kg/year                                | sum                             | of (265)(271) = |   | 1264.63 | (272) |
|   |                                 |                 |   |         |       |

TER =



# 

|   |   |                      | User D      | etails:      |             |             |                       |                   |                           |                     |
|---|---|----------------------|-------------|--------------|-------------|-------------|-----------------------|-------------------|---------------------------|---------------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 20  | Versio               | n: 1.0.4.23 |              |             |             |                       |                   |                           |                     |
| Address :   | 1 Bed Flat, 219-22  |                      |             | Address:     |             | nh lunct    | tion I ON             |                   |                           |                     |
| 1. Overall dwelling dime  |   | 5 Columan            |             | ne, Loug     | μηροιοαί    | gri Jurici  |                       |                   |                           |                     |
| Ground floor  |   |                      | Area<br>5   |              | (1a) x      | <b></b>     | <b>ight(m)</b><br>2.5 | (2a) =            | <b>Volume(m</b><br>129.25 | <b>3)</b><br>(3a)   |
| Total floor area TFA = (1a  | a)+(1b)+(1c)+(1d)+(1  | e)+(1n)              | 5           | 51.7         | (4)         |             |                       |                   |                           |                     |
| Dwelling volume   |   |                      |             |              | (3a)+(3b)   | +(3c)+(3c   | l)+(3e)+              | .(3n) =           | 129.25                    | (5)                 |
| 2. Ventilation rate:  |   |                      |             |              |             |             |                       |                   |                           |                     |
| Number of chimneys  |   | secondary<br>heating | /<br>] + [  | 0<br>0       | ] = [       | total<br>0  |                       | 40 =              | m³ per hou                | ır<br>(6a)          |
| Number of open flues  | 0 +   | 0                    | +           | 0            | =           | 0           | x 2                   | 20 =              | 0                         | (6b)                |
| Number of intermittent fai  | ns  |                      |             |              |             | 2           | x ^                   | 10 =              | 20                        | (7a)                |
| Number of passive vents   |   |                      |             |              | Γ           | 0           | x ´                   | 10 =              | 0                         | (7b)                |
| Number of flueless gas fi   | res   |                      |             |              | Ē           | 0           | X 4                   | 40 =              | 0                         | (7c)                |
| Infiltration due to chimney   | vs, flues and fans = (  | 6a)+(6b)+(7a         | a)+(7b)+(7  | 7c) =        | Г           | 20          |                       | Air ch<br>÷ (5) = | anges per he              | our<br>(8)          |
| If a pressurisation test has be<br>Number of storeys in the<br>Additional infiltration<br>Structural infiltration: 0.<br>if both types of wall are pr<br>deducting areas of opening | ne dw <mark>elling</mark> (ns)<br>25 for steel or timber<br>resent, use the value corre | frame or (           | 0.35 for    | masonr       | y constr    |             |                       | -1]x0.1 =         | 0 0 0                     | (9)<br>(10)<br>(11) |
| If suspended wooden f   | - · · ·   | aled) or 0.1         | l (seale    | d), else     | enter 0     |             |                       | [                 | 0                         | (12)                |
| If no draught lobby, ent  |   | ,                    | ,           | ,.           |             |             |                       |                   | 0                         | (13)                |
| Percentage of windows   | s and doors draught s   | stripped             |             |              |             |             |                       |                   | 0                         | (14)                |
| Window infiltration   |   |                      |             | 0.25 - [0.2  | x (14) ÷ 1  | = [00       |                       |                   | 0                         | (15)                |
| Infiltration rate   |   |                      |             | (8) + (10) · | + (11) + (1 | 2) + (13) - | + (15) =              |                   | 0                         | (16)                |
| Air permeability value,   |   |                      | •           |              | •           | etre of e   | envelope              | area              | 5                         | (17)                |
| If based on air permeabili  | •   |                      |             |              |             |             |                       |                   | 0.4                       | (18)                |
| Air permeability value applies<br>Number of sides sheltere  |   | as been done         | e or a deg  | iree air pei | meability   | is being u  | sed                   | I                 |                           |                     |
| Shelter factor  | u   |                      |             | (20) = 1 - [ | 0.075 x (1  | 9)] =       |                       |                   | 3<br>0.78                 | (19)<br>(20)        |
| Infiltration rate incorporati   | ing shelter factor  |                      |             | (21) = (18)  | x (20) =    |             |                       | l                 | 0.31                      | (21)                |
| Infiltration rate modified for  | -   | ed                   |             |              |             |             |                       | Į                 | 0.01                      |                     |
|   | Mar Apr May   | 1 1                  | Jul         | Aug          | Sep         | Oct         | Nov                   | Dec               |                           |                     |
| Monthly average wind spe  | eed from Table 7  |                      |             |              |             |             |                       |                   |                           |                     |
| r r   | 4.9 4.4 4.3   | 3.8                  | 3.8         | 3.7          | 4           | 4.3         | 4.5                   | 4.7               |                           |                     |
| Wind Factor (22a)m = (22  | 2)m ÷ 4   | <u> </u>             |             |              |             |             |                       |                   |                           |                     |
| (22a)m= 1.27 1.25   | 1.23 1.1 1.08   | 0.95                 | 0.95        | 0.92         | 1           | 1.08        | 1.12                  | 1.18              |                           |                     |
|   |   |                      |             |              |             |             |                       |                   |                           |                     |

| Adjuste               | ed infiltr | ation rat                       | e (allow                  | ing for sh                    | elter an     | d wind s    | peed) =     | (21a) x      | (22a)m       |                    |                  |                      |           |         |
|-----------------------|------------|---------------------------------|---------------------------|-------------------------------|--------------|-------------|-------------|--------------|--------------|--------------------|------------------|----------------------|-----------|---------|
|                       | 0.4        | 0.39                            | 0.38                      | 0.35                          | 0.34         | 0.3         | 0.3         | 0.29         | 0.31         | 0.34               | 0.35             | 0.37                 | ]         |         |
|                       |            | c <i>tive air</i><br>al ventila | -                         | rate for ti                   | he applic    | cable ca    | se          |              |              |                    |                  |                      | 0         | (23a)   |
|                       |            |                                 |                           | endix N, (2                   | 3b) = (23a   | ) × Fmv (e  | equation (N | N5)) , othe  | rwise (23b   | ) = (23a)          |                  |                      | 0         | (23b)   |
| lf bala               | anced with | n heat reco                     | overy: effic              | iency in %                    | allowing for | or in-use f | actor (from | n Table 4h   | ) =          |                    |                  |                      | 0         | (23c)   |
| a) If                 | balance    | d mech                          | anical ve                 | entilation                    | with hea     | at recove   | ery (MVI    | HR) (24a     | a)m = (22    | 2b)m + (           | 23b) × [′        | 1 – (23c)            | ÷ 100]    | `       |
| (24a)m=               | 0          | 0                               | 0                         | 0                             | 0            | 0           | 0           | 0            | 0            | 0                  | 0                | 0                    | ]         | (24a)   |
| b) If                 | balance    | d mech                          | anical ve                 | entilation                    | without      | heat rec    | overy (N    | /IV) (24b    | )m = (22     | 2b)m + (2          | 23b)             |                      | •         |         |
| (24b)m=               | 0          | 0                               | 0                         | 0                             | 0            | 0           | 0           | 0            | 0            | 0                  | 0                | 0                    | ]         | (24b)   |
| ,                     |            |                                 |                           | ntilation c                   | •            | •           |             |              |              |                    |                  |                      |           |         |
| 1                     | · ,        | 1                               | r í                       | then (240                     | , ,<br>      |             |             | r i          | ŕ            | r È                | ŕ                | 1                    | 1         |         |
| (24c)m=               |            | 0                               | 0                         | 0                             | 0            | 0           | 0           | 0            | 0            | 0                  | 0                | 0                    |           | (24c)   |
| ,                     |            |                                 |                           | ole hous $m = (22t)$          |              | •           |             |              |              | 0.51               |                  |                      |           |         |
| (24d)m=               | , <i>,</i> | 0.58                            | 0.57                      | 0.56                          | 0.56         | 0.54        | 0.54        | 0.54         | 0.55         | 0.56               | 0.56             | 0.57                 | 1         | (24d)   |
| Effe                  | ctive air  | change                          | rate - er                 | nter (24a                     | ) or (24b    | ) or (24    | c) or (24   | d) in boy    | (25)         |                    |                  |                      | 1         |         |
| (25)m=                | 0.58       | 0.58                            | 0.57                      | 0.56                          | 0.56         | 0.54        | 0.54        | 0.54         | 0.55         | 0 <mark>.56</mark> | 0.56             | 0.57                 |           | (25)    |
| 2 40                  | atlassa    | c and h                         |                           | paramete                      |              |             |             |              |              |                    |                  |                      | ,         |         |
| ELEN                  |            | S and he<br>Gros                |                           | Openin                        |              | Net Ar      | ea          | U-valu       |              | AXU                |                  | k-value              |           | AXk     |
|                       |            | area                            |                           | m                             |              | A ,r        |             | W/m2         |              | (W/I               | K)               | kJ/m <sup>2</sup> ·l |           | kJ/K    |
| Windov                | ws Type    | e 1                             |                           |                               |              | 10.63       | x1,         | /[1/( 1.4 )+ | 0.04] =      | 14.09              |                  |                      |           | (27)    |
| Windov                | ws Type    | 2                               |                           |                               |              | 2.3         | x1,         | /[1/( 1.4 )+ | 0.04] =      | 3.05               |                  |                      |           | (27)    |
| Wall <mark>s</mark> 7 | Гуре1      | 29                              | ,                         | 10.63                         | 3            | 18.37       | ×           | 0.18         |              | 3.31               |                  |                      |           | (29)    |
| Walls 7               | Гуре2      | 5                               |                           | 2.3                           |              | 2.7         | ×           | 0.18         | ] = [        | 0.49               |                  |                      |           | (29)    |
| Walls 7               | Гуре3      | 18                              | 3                         | 0                             |              | 18          | x           | 0.18         | = [          | 3.24               |                  |                      |           | (29)    |
| Total a               | rea of e   | lements                         | , m²                      |                               |              | 52          |             |              |              |                    |                  |                      |           | (31)    |
| Party v               | vall       |                                 |                           |                               |              | 44.25       | 5 x         | 0            | =            | 0                  |                  |                      |           | (32)    |
| Party f               | loor       |                                 |                           |                               |              | 51.7        |             |              |              |                    | [                |                      | 7         | (32a)   |
| Party c               | eiling     |                                 |                           |                               |              | 51.7        |             |              |              |                    | Γ                |                      | $\exists$ | (32b)   |
| Interna               | l wall **  |                                 |                           |                               |              | 77          |             |              |              |                    | Γ                |                      | $\dashv$  | (32c)   |
|                       |            |                                 |                           | effective wil<br>nternal wall |              |             | ated using  | formula 1    | /[(1/U-valu  | ie)+0.04] a        | ∎<br>as given in | paragraph            | n 3.2     |         |
| Fabric                | heat los   | s, W/K                          | = S (A x                  | U)                            |              |             |             | (26)(30)     | + (32) =     |                    |                  |                      | 24.1      | 7 (33)  |
| Heat c                | apacity    | Cm = S                          | (A x k )                  |                               |              |             |             |              | ((28)        | .(30) + (32        | 2) + (32a).      | (32e) =              | 1409      | )2 (34) |
| Therma                | al mass    | parame                          | eter (TMI                 | ⊃ = Cm ÷                      | TFA) in      | ⊨kJ/m²K     |             |              | Indica       | tive Value         | : Medium         |                      | 250       | (35)    |
|                       | •          |                                 | ere the de<br>tailed calc | tails of the<br>ulation.      | constructi   | on are not  | t known pr  | ecisely the  | e indicative | values of          | TMP in Ta        | able 1f              |           |         |
| Therma                | al bridg   | es : S (L                       | x Y) cal                  | culated u                     | ising Ap     | pendix ł    | <           |              |              |                    |                  |                      | 5.31      | (36)    |
|                       |            |                                 | are not kr                | own (36) =                    | : 0.05 x (3  | 1)          |             |              |              | <i>(</i> )         |                  |                      |           |         |
|                       | abric he   |                                 | -11-4                     | 1                             | _            |             |             |              |              | (36) =             | 05) (5)          |                      | 29.4      | 8 (37)  |
| ventila               |            | i                               | i                         | d monthly                     |              | 1           | 11          | Δ            |              | · · · · ·          | 25)m x (5)       | i _                  | 1         |         |
|                       | Jan        | Feb                             | Mar                       | Apr                           | May          | Jun         | Jul         | Aug          | Sep          | Oct                | Nov              | Dec                  | J         |         |

| (38)m=     | 24.74                | 24.6                 | 24.48              | 23.87                      | 23.75       | 23.22                  | 23.22               | 23.12       | 23.42        | 23.75                  | 23.98                            | 24.22     |         | (38) |
|------------|----------------------|----------------------|--------------------|----------------------------|-------------|------------------------|---------------------|-------------|--------------|------------------------|----------------------------------|-----------|---------|------|
| Heat tr    | ansfer o             | coefficie            | nt, W/K            |                            |             |                        |                     |             | (39)m        | = (37) + (3            | 38)m                             |           |         |      |
| (39)m=     | 54.22                | 54.09                | 53.96              | 53.35                      | 53.24       | 52.7                   | 52.7                | 52.61       | 52.91        | 53.24                  | 53.47                            | 53.71     |         |      |
| Heat In    | nse nara             | meter (l             | HLP), W            | /m²K                       |             |                        |                     |             |              | Average =<br>= (39)m ÷ | Sum(39) <sub>1</sub>             | 12 /12=   | 53.35   | (39) |
| (40)m=     | 1.05                 | 1.05                 | 1.04               | 1.03                       | 1.03        | 1.02                   | 1.02                | 1.02        | 1.02         | 1.03                   | 1.03                             | 1.04      |         |      |
|            |                      |                      | I                  |                            |             |                        |                     |             | <u> </u>     | Average =              | Sum(40)1                         | 12 /12=   | 1.03    | (40) |
| Numbe      | er of day            | /s in mo             | nth (Tab           | le 1a)                     | i           | i                      | i                   |             |              |                        |                                  |           | I       |      |
|            | Jan                  | Feb                  | Mar                | Apr                        | May         | Jun                    | Jul                 | Aug         | Sep          | Oct                    | Nov                              | Dec       |         | (44) |
| (41)m=     | 31                   | 28                   | 31                 | 30                         | 31          | 30                     | 31                  | 31          | 30           | 31                     | 30                               | 31        |         | (41) |
| 4 367      |                      |                      |                    |                            |             |                        |                     |             |              |                        |                                  |           |         |      |
| 4. Wa      | iter heat            | ting ene             | rgy requ           | irement:                   |             |                        |                     |             |              |                        |                                  | kWh/ye    | ear:    |      |
|            |                      | upancy,              |                    | 14                         | ( 0.000     | 40 · · /TI             | - 40.0              |             | 040/         |                        |                                  | .74       |         | (42) |
|            | A > 13.9<br>A £ 13.9 | -                    | +1.76 x            | [1 - exp                   | (-0.0003    | 649 X (11              | -A -13.9            | )2)] + 0.0  | JU13 X (     | IFA -13.               | .9)                              |           |         |      |
|            |                      |                      |                    | ge in litre                |             |                        |                     |             |              |                        |                                  | i.53      |         | (43) |
|            |                      | -                    |                    | usage by .<br>r day (all w |             | -                      | -                   | to achieve  | a water us   | se target o            | t                                |           |         |      |
|            | Jan                  | Feb                  | Mar                | Apr                        | May         | Jun                    | Jul                 | Aug         | Sep          | Oct                    | Nov                              | Dec       | L       |      |
| Hot wate   | er usage i           | n litres pei         |                    | ach month                  |             |                        | Table 1c x          | <u> </u>    |              |                        |                                  |           |         |      |
| (44)m=     | <mark>8</mark> 3.08  | 80.06                | 77.04              | 74.02                      | 71          | 67.98                  | 67. <mark>98</mark> | 71          | 74.02        | 77.04                  | 80.06                            | 83.08     |         |      |
| Enorm      | pontont of           | bot water            | unod on            | culated mo                 | opthly - A  | 100 v Vd r             |                     | Tm ( 2600   |              |                        | m(44) <sub>112</sub> =           |           | 906.36  | (44) |
|            | 123.21               |                      |                    |                            |             |                        |                     | -           |              |                        |                                  |           |         |      |
| (45)m=     | 123.21               | 107.76               | 111.2              | 96.95                      | 93.02       | 80.27                  | 74.38               | 85.36       | 86.37        | 100.66<br>Total = Su   | 109.88<br>m(45) <sub>112</sub> = | 119.32    | 1188.38 | (45) |
| lf instant | taneous w            | vater heati          | ng at point        | of use (no                 | o hot water | <sup>r</sup> storage), | enter 0 in          | boxes (46   |              |                        |                                  |           |         | `    |
| (46)m=     | 18.48                | 16.16                | 16.68              | 14.54                      | 13.95       | 12.04                  | 11.16               | 12.8        | 12.96        | 15.1                   | 16.48                            | 17.9      |         | (46) |
|            | storage              |                      | includir           | ng any so                  | alar or M   |                        | storage             | within c    |              | دما                    |                                  | 0         | l       | (47) |
| -          |                      |                      |                    | ink in dw                  |             |                        | -                   |             |              | 301                    |                                  | 0         |         | (47) |
|            |                      | -                    |                    | er (this in                | -           |                        |                     | . ,         | ers) ente    | er '0' in (            | 47)                              |           |         |      |
|            | storage              |                      |                    |                            |             | <i></i>                | <i>.</i>            |             |              |                        |                                  |           | I       |      |
|            |                      |                      |                    | oss facto                  | or is kno   | wn (kvvr               | n/day):             |             |              |                        |                                  | 0         |         | (48) |
| -          |                      |                      | m Table            | ∈∠b<br>e, kWh/ye           | aar         |                        |                     | (48) x (49) | \ _          |                        |                                  | 0         |         | (49) |
|            |                      |                      | •                  | cylinder l                 |             | or is not              |                     | (40) × (40) | / –          |                        |                                  | 0         |         | (50) |
|            |                      | -                    |                    | om Tabl                    | e 2 (kW     | h/litre/da             | ıy)                 |             |              |                        |                                  | 0         |         | (51) |
|            |                      | ieating s<br>from Ta | ee secti<br>ble 2a | on 4.3                     |             |                        |                     |             |              |                        |                                  | 0         | l       | (52) |
|            |                      |                      | m Table            | 2b                         |             |                        |                     |             |              |                        |                                  | 0<br>0    |         | (52) |
| Energy     | / lost fro           | m watei              | storage            | , kWh/ye                   | ear         |                        |                     | (47) x (51) | ) x (52) x ( | 53) =                  |                                  | 0         |         | (54) |
| Enter      | (50) or (            | (54) in (5           | 55)                |                            |             |                        |                     |             |              |                        |                                  | 0         |         | (55) |
| Water      | storage              | loss cal             | culated            | for each                   | month       | -                      | -                   | ((56)m = (  | 55) × (41)   | m                      | -                                |           |         |      |
| (56)m=     | 0                    | 0                    | 0                  | 0                          | 0           | 0                      | 0                   | 0           | 0            | 0                      | 0                                | 0         |         | (56) |
| -          | er contains          | s dedicate           | d solar sto        | rage, (57)i                | m = (56)m   | x [(50) – (            | H11)] ÷ (5          | 0), else (5 | 7)m = (56)   | m where (              | H11) is fro                      | om Append | ix H    |      |
| (57)m=     | 0                    | 0                    | 0                  | 0                          | 0           | 0                      | 0                   | 0           | 0            | 0                      | 0                                | 0         |         | (57) |

| Primary circuit                 | t loss (ar    | nnual) fro | om Table            | e 3        |           |                      |                      |                  |                           |             | 0           |                         | (58) |
|---------------------------------|---------------|------------|---------------------|------------|-----------|----------------------|----------------------|------------------|---------------------------|-------------|-------------|-------------------------|------|
| Primary circuit<br>(modified by |               |            |                     |            |           | . ,                  | . ,                  |                  | r thermo                  | stat)       |             |                         |      |
| (59)m= 0                        |               | 0          | 0                   | 0          |           |                      |                      | 0                | 0                         | 0           | 0           |                         | (59) |
| Combi loss ca                   | lculated      | for each   | month               | (61)m =    | (60) ÷ 30 | 65 × (41)            | )m                   |                  |                           |             |             |                         |      |
| (61)m= 42.34                    | 36.85         | 39.26      | 36.5                | 36.18      | 33.52     | 34.64                | 36.18                | 36.5             | 39.26                     | 39.48       | 42.34       |                         | (61) |
| Total heat req                  | uired for     | water he   | eating ca           | alculated  | for eac   | h month              | (62)m =              | 0.85 × 0         | (45)m +                   | (46)m +     | (57)m +     | (59)m + (6 <sup>2</sup> | 1)m  |
| (62)m= 165.55                   | 144.61        | 150.46     | 133.45              | 129.2      | 113.79    | 109.02               | 121.54               | 122.88           | 139.92                    | 149.36      | 161.66      |                         | (62) |
| Solar DHW input                 | calculated    | using App  | endix G o           | r Appendix | H (negati | ve quantity          | /) (enter '0         | ' if no sola     | r contribut               | ion to wate | er heating) |                         |      |
| (add additiona                  | I lines if    | FGHRS      | and/or \            | WHRS       | applies   | , see Ap             | pendix (             | G)               | i                         | i           | i           |                         |      |
| (63)m= 0                        | 0             | 0          | 0                   | 0          | 0         | 0                    | 0                    | 0                | 0                         | 0           | 0           |                         | (63) |
| Output from w                   | ater hea      | ter        |                     |            |           |                      |                      |                  |                           |             |             |                         |      |
| (64)m= 165.55                   | 144.61        | 150.46     | 133.45              | 129.2      | 113.79    | 109.02               | 121.54               | 122.88           | 139.92                    | 149.36      | 161.66      |                         |      |
|                                 |               |            |                     |            |           |                      | Outp                 | out from w       | ater heate                | r (annual)₁ | 12          | 1641.44                 | (64) |
| Heat gains fro                  | m water       | heating,   | kWh/m               | onth 0.2   | 5 ´ [0.85 | × (45)m              | + (61)m              | n] + 0.8 x       | k [(46)m                  | + (57)m     | + (59)m     | ]                       |      |
| (65)m= 51.55                    | 45.04         | 46.79      | 41.36               | 39.97      | 35.07     | 33.39                | 37.43                | 37.85            | 43.28                     | 46.41       | 50.26       |                         | (65) |
| in <mark>clude (57</mark> )     | m in cal      | culation   | of (65)m            | only if c  | ylinder i | s in the o           | dwelling             | or hot w         | ate <mark>r is f</mark> r | om com      | munity h    | eating                  |      |
| 5. Internal g                   | ains (see     | Table 5    | 5 and 5a            | ):         |           |                      |                      |                  |                           |             |             |                         |      |
| Met <mark>abolic</mark> gair    | ns (Table     | e 5), Wat  | ts                  |            |           |                      |                      |                  |                           |             |             |                         |      |
| Jan                             | Feb           | Mar        | Apr                 | May        | Jun       | Jul                  | Aug                  | Sep              | Oct                       | Nov         | Dec         |                         |      |
| (66)m= 87.01                    | 87.01         | 87.01      | 87. <mark>01</mark> | 87.01      | 87.01     | 8 <mark>7</mark> .01 | 87.01                | 87.01            | 8 <mark>7.01</mark>       | 87.01       | 87.01       |                         | (66) |
| Ligh <mark>ting g</mark> ains   | (calcula      | ted in Ap  | opendix             | L, equat   | ion L9 o  | r L9a), a            | lso see <sup>·</sup> | Table 5          |                           |             | -           |                         |      |
| (67)m= 13.52                    | 12.01         | 9.77       | 7.39                | 5.53       | 4.67      | 5.04                 | 6.55                 | 8.8              | 11.17                     | 13.03       | 13.9        |                         | (67) |
| Appliances ga                   | ins (calc     | ulated in  | Append              | dix L, eq  | uation L  | 13 or L1             | 3a), also            | see Ta           | ble 5                     |             |             |                         | I    |
| (68)m= 151.65                   | 153.22        | 149.26     | 140.81              | 130.16     | 120.14    | 113.45               | 111.88               | 115.84           | 124.28                    | 134.94      | 144.96      |                         | (68) |
| Cooking gains                   | (calcula      | ted in A   | ppendix             | L, equat   | tion L15  | or L15a)             | , also se            | ee Table         | 5                         |             |             |                         |      |
| (69)m= 31.7                     | 31.7          | 31.7       | 31.7                | 31.7       | 31.7      | 31.7                 | 31.7                 | 31.7             | 31.7                      | 31.7        | 31.7        |                         | (69) |
| Pumps and fa                    | ns gains      | (Table 5   | 5a)                 |            |           |                      |                      |                  |                           |             |             |                         |      |
| (70)m= 3                        | 3             | 3          | 3                   | 3          | 3         | 3                    | 3                    | 3                | 3                         | 3           | 3           |                         | (70) |
| Losses e.g. ev                  | ,<br>aporatio | n (nega    | tive valu           | es) (Tab   | le 5)     |                      |                      |                  |                           |             |             |                         |      |
| (71)m= -69.61                   | -69.61        | -69.61     | -69.61              | -69.61     | -69.61    | -69.61               | -69.61               | -69.61           | -69.61                    | -69.61      | -69.61      |                         | (71) |
| Water heating                   | gains (1      | able 5)    |                     |            |           |                      |                      |                  | 1                         |             |             |                         |      |
| (72)m= 69.29                    | 67.03         | 62.89      | 57.44               | 53.73      | 48.71     | 44.88                | 50.3                 | 52.56            | 58.18                     | 64.45       | 67.55       |                         | (72) |
| Total internal                  | aains =       | !<br>:     | I                   | 1          | (66)      | ı<br>m + (67)m       | ı<br>+ (68)m -       | I<br>+ (69)m + ∣ | ı<br>(70)m + (7           | 1)m + (72)  | m           |                         |      |
| (73)m= 286.56                   | 284.36        | 274.01     | 257.75              | 241.52     | 225.62    | 215.48               | 220.84               | 229.3            | 245.73                    | 264.53      | 278.51      |                         | (73) |
| 6. Solar gain                   | s:            | 1          |                     | 1          | 1         | 1                    | 1                    | 1                | 1                         |             |             |                         |      |
| Solar gains are                 |               | using sola | r flux from         | Table 6a   | and assoc | iated equa           | itions to co         | onvert to th     | ne applicat               | le orientat | ion.        |                         |      |
|                                 |               |            | <b>A</b>            |            |           |                      |                      | -                |                           |             |             | Caina                   |      |

| Orientation:   | Access Facto<br>Table 6d | r | Area<br>m² | Flux<br>Table 6a |       |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|----------------|--------------------------|---|------------|------------------|-------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x | 0.77                     | x | 2.3        | x                | 11.28 | x | 0.63           | x | 0.7            | = | 7.93         | (75) |
| Northeast 0.9x | 0.77                     | x | 2.3        | x                | 22.97 | × | 0.63           | × | 0.7            | = | 16.14        | (75) |

|  |                    |                             | -        |                             | י ר          |              |                     |                               |        | [                    | <b>—</b> ]           |
|--|--------------------|-----------------------------|----------|-----------------------------|--------------|--------------|---------------------|-------------------------------|--------|----------------------|----------------------|
| Northeast 0.9x 0.77                      | ×                  | 2.3                         | ×        | 41.38                       |              | 0.63         |                     | 0.7                           | =      | 29.09                | (75)                 |
| Northeast 0.9x 0.77                      | ×                  | 2.3                         | ×        | 67.96                       | ×            | 0.63         |                     | 0.7                           | =      | 47.77                | (75)                 |
| Northeast 0.9x 0.77                      | X                  | 2.3                         | ×        | 91.35                       | X            | 0.63         |                     | 0.7                           | =      | 64.21                | (75)                 |
| Northeast 0.9x 0.77                      | X                  | 2.3                         | ×        | 97.38                       | ×            | 0.63         | _ × [               | 0.7                           | =      | 68.45                | (75)                 |
| Northeast 0.9x 0.77                      | x                  | 2.3                         | x        | 91.1                        | ×            | 0.63         | ×                   | 0.7                           | =      | 64.04                | (75)                 |
| Northeast 0.9x 0.77                      | X                  | 2.3                         | x        | 72.63                       | ×            | 0.63         | x                   | 0.7                           | =      | 51.05                | (75)                 |
| Northeast 0.9x 0.77                      | X                  | 2.3                         | x        | 50.42                       | ×            | 0.63         | x                   | 0.7                           | =      | 35.44                | (75)                 |
| Northeast 0.9x 0.77                      | x                  | 2.3                         | x        | 28.07                       | ×            | 0.63         | ×                   | 0.7                           | =      | 19.73                | (75)                 |
| Northeast 0.9x 0.77                      | x                  | 2.3                         | x        | 14.2                        | x            | 0.63         | ×                   | 0.7                           | =      | 9.98                 | (75)                 |
| Northeast 0.9x 0.77                      | x                  | 2.3                         | x        | 9.21                        | <b>x</b>     | 0.63         | ×                   | 0.7                           | =      | 6.48                 | (75)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 36.79                       | ] [          | 0.63         | x                   | 0.7                           | =      | 119.53               | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 62.67                       | ] [          | 0.63         | x                   | 0.7                           | =      | 203.61               | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 85.75                       | ] [          | 0.63         | ×                   | 0.7                           | =      | 278.58               | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 106.25                      | ] [          | 0.63         | ×                   | 0.7                           | =      | 345.18               | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 119.01                      | ] [          | 0.63         | ×                   | 0.7                           | =      | 386.63               | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 118.15                      | ĪĪ           | 0.63         | ×                   | 0.7                           | =      | 383.83               | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 113.91                      | Ì ſ          | 0.63         | ×                   | 0.7                           | =      | 370.05               | (79)                 |
| Southwest0.9x 0.77                       | x                  | 10.63                       | X        | 104.39                      |              | 0.63         | x                   | 0.7                           | =      | 339.13               | (79)                 |
| Southwest0.9x 0.77                       | ×                  | 10.63                       | x        | 92.85                       | i i          | 0.63         | x                   | 0.7                           |        | 3 <mark>01.64</mark> | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | x                  | 10.63                       | x        | 69.27                       | i /i         | 0.63         | x                   | 0.7                           | =      | 2 <mark>25.03</mark> | (79)                 |
| Southwest0.9x 0.77                       | x                  | 10.63                       | ] x      | 44.07                       | i i          | 0.63         | ×                   | 0.7                           | =      | 143.17               | (79)                 |
| Southwest <sub>0.9x</sub> 0.77           | ×                  | 10.63                       | T x      | 31.49                       | í í          | 0.63         | ×                   | 0.7                           | -      | 102.29               | (79)                 |
|  |                    |                             | -        |                             |              |              |                     |                               |        |                      |                      |
| Solar gains in watts, ca                 | alculated          | for each mor                | nth      |                             | (83)m        | = Sum(74)m . | <mark>(8</mark> 2)m |                               |        |                      |                      |
| (83)m= 127.46 219.75                     | 307.67             | 392.94 450.8                | 33 4     | 52.28 434.09                | 390.         | 18 337.09    | 244.76              | 153.15                        | 108.77 |                      | (83)                 |
| Total gains – internal a                 | ind solar          | (84)m = (73)                | m + (    | 83)m , watts                |              |              |                     |                               |        | -                    |                      |
| (84)m= 414.02 504.11                     | 581.68             | 650.7 692.3                 | 35 (     | 677.9 649.57                | 611.         | 02 566.39    | 490.49              | 417.68                        | 387.28 |                      | (84)                 |
| 7. Mean internal temp                    | erature            | (heating seas               | on)      |                             |              |              |                     |                               |        |                      |                      |
| Temperature during h                     | leating p          | eriods in the l             | iving    | area from Ta                | ble 9,       | Th1 (°C)     |                     |                               |        | 21                   | (85)                 |
| Utilisation factor for g                 | ains for I         | iving area, h1              | ,m (s    | ee Table 9a)                |              |              |                     |                               |        |                      |                      |
| Jan Feb                                  | Mar                | Apr Ma                      | iy 🗌     | Jun Jul                     | Αι           | ıg Sep       | Oct                 | Nov                           | Dec    |                      |                      |
| (86)m= 0.99 0.98                         | 0.94               | 0.84 0.68                   | 3        | 0.49 0.36                   | 0.3          | 9 0.62       | 0.89                | 0.98                          | 0.99   |                      | (86)                 |
| Mean internal temper                     | ature in           | living area T1              | (follo   | ow steps 3 to <sup>-</sup>  | 7 in T       | able 9c)     |                     | -                             |        |                      |                      |
| (87)m= 20.08 20.3                        | 20.56              | 20.82 20.9                  | <u> </u> | 20.99 21                    | 21           | <u>′</u>     | 20.78               | 20.38                         | 20.04  |                      | (87)                 |
| Temperature during h                     |                    | eriode in rest              | of dv    | velling from Tr             | ahla C       | <br>         |                     | 1                             |        | 1                    |                      |
| (88)m= 20.04 20.04                       | 20.05              | 20.06 20.0                  | - 1      | 20.07 20.07                 | 20.0         |              | 20.06               | 20.05                         | 20.05  |                      | (88)                 |
|  |                    |                             |          |                             |              |              |                     |                               |        | I                    | × /                  |
|  | . ,                |                             |          |                             |              |              |                     |                               |        |                      |                      |
| Utilisation factor for g                 |                    |                             | <u> </u> | i                           | т <u>́</u>   | 2 0.55       | 0.96                | 0.07                          | 0.00   | 1                    | (80)                 |
| (89)m= 0.99 0.97                         | 0.92               | 0.81 0.62                   | 2        | 0.42 0.28                   | 0.3          |              | 0.86                | 0.97                          | 0.99   |                      | (89)                 |
| (89)m= 0.99 0.97<br>Mean internal temper | 0.92<br>ature in t | 0.81 0.62<br>the rest of dw | elling   | 0.42 0.28<br>T2 (follow ste | 0.3<br>eps 3 | to 7 in Tabl | e 9c)               | 1                             |        | ]                    |                      |
| (89)m= 0.99 0.97                         | 0.92               | 0.81 0.62                   | elling   | 0.42 0.28                   | 0.3          | to 7 in Tabl | e 9c)<br>19.83      | 0.97<br>19.28<br>ng area ÷ (4 | 18.78  | 0.51                 | (89)<br>(90)<br>(91) |

|  |  | مارين مرما فرم  |  | ()  | A T4                                    | . (4 4  |  |   |  |  |                          |  |
|--|--|---|--|---|---|---|--|---|--|--|--------------------------|--|
| Mean internal tem<br>(92)m= 19.47 19.7   | `  | 20.35   | 20.49  | 11ng) = 1<br>20.53  | LA × 11<br>20.54                        | + (1 – TL<br>20.54  | A) × 12<br>20.52   | 20.31   | 19.84  | 19.42  |                          | (92)   |
| Apply adjustment   |  |   |  |   |   |   |  |   | 19.04  | 19.42  |                          | (32)   |
| (93)m= 19.47 19.7  |  | 20.35   | 20.49  | 20.53   | 20.54                                   | 20.54   | 20.52  | 20.31   | 19.84  | 19.42  |                          | (93)   |
| 8. Space heating r   |  | 1   |  | 20100   | 2010 1                                  | 2010 1  |  | 20101   |  |  |                          |  |
| Set Ti to the mean   |  |   | re obtain  | ed at ste   | ep 11 of                                | Table 9   | o, so tha  | t Ti.m=(  | 76)m an  | d re-calo  | ulate                    |  |
| the utilisation facto  |  | •   |  |   | ор <b>с</b> .                           |   |  | , (   |  |  |                          |  |
| Jan Fe   | b Mar  | Apr   | May  | Jun   | Jul                                     | Aug   | Sep  | Oct   | Nov  | Dec  |                          |  |
| Utilisation factor for   | r gains, hn  | n:  |  |   |   |   |  |   |  | -  |                          |  |
| (94)m= 0.99 0.9  | 0.92   | 0.82  | 0.65   | 0.46  | 0.32                                    | 0.36  | 0.58   | 0.87  | 0.97   | 0.99   |                          | (94)   |
| Useful gains, hmG  | `  | <del>rí - `</del>   | r i  |   | ·                                       |   | · · · · · ·  |   | ·  |  | l                        |  |
| (95)m= 408.96 488.   |  | 532.16  | 448.92   | 310.45  | 207.36                                  | 217.31  | 331.27   | 425.53  | 406.09   | 383.79   |                          | (95)   |
| Monthly average e  |  | r –   |  |   |   |   |  |   |  |  |                          | (00)   |
| (96)m= 4.3 4.9   | 6.5  | 8.9   | 11.7   | 14.6  | 16.6                                    | 16.4  | 14.1   | 10.6  | 7.1  | 4.2  |                          | (96)   |
| Heat loss rate for r   |  | 610.76  | 468.05   |   | =[(39)m :<br>207.62                     | x [(93)m<br>217.77  | <u> </u>   | ]<br>517.18   | 681.01   | 017.46   |                          | (97)   |
| (97)m= 822.57 802.<br>Space heating req  |  |   |  | 312.78  |   |   | 339.64   |   |  | 817.46   |                          | (37)   |
| (98)m= 307.73 211.   |  | 56.59   | 14.24  | 0   | 11 = 0.02                               | 4 X [(97  | 0  | 68.19   | 197.94   | 322.65   |                          |  |
|  | 144.01   | 00.00   | 14.24  | Ū   | Ŭ                                       | -   | l per year   |   |  |  | 1322.71                  | (98)   |
|  |  |   |  |   |   |   | ii per year  | (KVVII/yeai   | ) = 0um(9  | 0)15,912 -   |                          |  |
| Space heating req  | urement ir   | n kvvh/m·   | /year  |   |   |   |  |   |  |  | 25.58                    | (99)   |
| 9a. Energy requirer  | ients – Ind  | lividu <mark>al h</mark>  | eating sy  | /stems i  | ncluding                                | micro-C   | HP)  |   |  |  |                          |  |
| Space heating:   |  |   | 1  |   |   |   |  |   |  |  |                          |  |
| Fraction of space I  |  |   |  | mentary   |   |   |  |   |  |  | 0                        | (201)  |
| Fraction of space I  | neat from r  | nain syst   | com(c)   |   |   |   | (004)  |   |  |  |                          |  |
|  |  |   |  |   |   |   | – (201) =  |   |  |  | 1                        | (202)  |
| Fraction of total he   | ating from   |   |  |   |   |   | - (201) =<br>02) × [1 -                                    | (203)] =  |  |  | 1                        | (202)  |
| Fraction of total he<br>Efficiency of main   |  | main sys  | stem 1   |   |   |   |  | (203)] =  |  |  |                          |  |
|  | space hear   | main syste  | stem 1<br>em 1   | g system  |   |   |  | (203)] =  |  |  | 1                        | (204)  |
| Efficiency of main   | space hear<br>dary/supp  | main syste  | stem 1<br>em 1   | g system<br>Jun   |   |   |  | (203)] =<br>Oct   | Nov  | Dec  | 1<br>93.4                | (204)<br>(206)<br>(208)  |
| Efficiency of main<br>Efficiency of secor  | space hear<br>dary/supp<br>b Mar   | main syste<br>ting syste<br>lementar  | stem 1<br>em 1<br>y heating<br>May   | Jun   | n, %                                    | (204) = (2  | 02) × [1 –   |   | Nov  | Dec  | 1<br>93.4<br>0           | (204)<br>(206)<br>(208)  |
| Efficiency of main<br>Efficiency of secor<br>Jan Fe  | space hear<br>dary/supp<br>b Mar<br>uirement (d  | main syste<br>ting syste<br>lementar  | stem 1<br>em 1<br>y heating<br>May   | Jun   | n, %                                    | (204) = (2  | 02) × [1 –   |   | Nov<br>197.94  | Dec<br>322.65                                      | 1<br>93.4<br>0           | (204)<br>(206)<br>(208)  |
| Efficiency of main<br>Efficiency of secor<br>Jan Fe<br>Space heating req   | space hear<br>dary/suppl<br>b Mar<br>uirement (0<br>06 144.31  | main system<br>lementar<br>Apr<br>calculate<br>56.59  | stem 1<br>em 1<br>y heating<br>May<br>d above)<br>14.24  | Jun   | n, %<br>Jul                             | (204) = (2<br>Aug   | 02) × [1 –<br>Sep  | Oct   | I  |  | 1<br>93.4<br>0           | (204)<br>(206)<br>(208)  |
| Efficiency of main<br>Efficiency of secor<br>Jan Fe<br>Space heating req<br>307.73 211.  | space hear<br>dary/supp<br>b Mar<br>uirement (o<br>06 144.31<br>(204)] } x 1   | main system<br>lementar<br>Apr<br>calculate<br>56.59  | stem 1<br>em 1<br>y heating<br>May<br>d above)<br>14.24  | Jun   | n, %<br>Jul                             | (204) = (2<br>Aug<br>0  | 02) × [1 -<br>Sep<br>0                                     | Oct<br>68.19<br>73.01   | 197.94<br>211.93   | 322.65<br>345.45                                   | 1<br>93.4<br>0           | (204)<br>(206)<br>(208)  |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x  | space hear<br>dary/supp<br>b Mar<br>uirement (o<br>06 144.31<br>(204)] } x 1   | main system<br>lementar<br>Apr<br>calculate<br>56.59  | stem 1<br>em 1<br>y heating<br>May<br>d above)<br>14.24<br>06)                                   | Jun<br>0  | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0  | 02) × [1 –<br>Sep<br>0                                     | Oct<br>68.19<br>73.01   | 197.94<br>211.93   | 322.65<br>345.45                                   | 1<br>93.4<br>0           | (204)<br>(206)<br>(208)  |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x  | space heat         dary/supp         b       Mar         uirement (0         06       144.31         (204)]       } x         97       154.51  | main system<br>lementar<br>Apr<br>calculate<br>56.59<br>100 ÷ (20<br>60.59  | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24                                 | Jun<br>0  | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0  | 02) × [1 -<br>Sep<br>0                                     | Oct<br>68.19<br>73.01   | 197.94<br>211.93   | 322.65<br>345.45                                   | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }  | space heat           dary/supple           b         Mar           uirement (model           06         144.31           (204)]         } x 1           07         154.51           (secondation)         (secondation)  | main system<br>lementar<br>Apr<br>calculate<br>56.59<br>100 ÷ (20<br>60.59  | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24                                 | Jun<br>0  | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0  | 02) × [1 -<br>Sep<br>0                                     | Oct<br>68.19<br>73.01   | 197.94<br>211.93   | 322.65<br>345.45                                   | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue  | space heat           dary/supple           b         Mar           uirement (model           06         144.31           (204)]         } x 1           07         154.51           (secondation)         (secondation)  | main system<br>lementar<br>Apr<br>calculate<br>56.59<br>100 ÷ (20<br>60.59  | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24                                 | Jun<br>0  | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota                                | 02) × [1 -<br>Sep<br>0<br>1 (kWh/yea                       | Oct<br>68.19<br>73.01<br>ar) =Sum(2<br>0  | 197.94<br>211.93<br>211) <sub>15.1012</sub><br>0   | 322.65<br>345.45<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }  | space heat         dary/supple         b       Mar         uirement (0         06       144.31         (204)]       } x         97       154.51         (secondate         x 100 ÷ (20)  | main system<br>lementar<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>28)   | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24                                 | Jun           0           0                                   | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota                                | 02) × [1 -<br>Sep<br>0<br>1 (kWh/yea                       | Oct<br>68.19<br>73.01<br>ar) =Sum(2<br>0  | 197.94<br>211.93<br>211) <sub>15.1012</sub><br>0   | 322.65<br>345.45<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }<br>(215)m= 0 0<br>Water heating  | space heat         dary/supple         b       Mar         uirement (d)         06       144.31         (204)]       } x          07       154.51         (secondard)         x 100 ÷ (20         0  | main systementar<br>lementar<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>28)<br>0   | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0                  | Jun           0           0                                   | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota                                | 02) × [1 -<br>Sep<br>0<br>0<br>I (kWh/yea                  | Oct<br>68.19<br>73.01<br>ar) =Sum(2<br>0  | 197.94<br>211.93<br>211) <sub>15.1012</sub><br>0   | 322.65<br>345.45<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)]}<br>(215)m= 0 0<br>Water heating<br>Output from water h  | space heat         dary/supple         b       Mar         uirement (0)         06       144.31         (204)]       } x         97       154.51         (secondation in the secondation in the secondati  | main system<br>lementar<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>28)<br>0  | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0                  | 0<br>0  | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota                   | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea<br>0<br>I (kWh/yea | Oct<br>68.19<br>73.01<br>ar) = Sum(2)<br>0<br>ar) = Sum(2)                              | 197.94<br>211.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 322.65<br>345.45<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }<br>(215)m = 0 0<br>Water heating<br>Output from water h<br>165.55 144.   | space heat         dary/supple         b       Mar         uirement (0)         06       144.31         (204)]       } x 7         07       154.51         (secondate         x 100 ÷ (20)         0         eater (calc         01       150.46   | main systementar<br>lementar<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>28)<br>0   | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0                  | Jun           0           0                                   | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota                                | 02) × [1 -<br>Sep<br>0<br>0<br>I (kWh/yea                  | Oct<br>68.19<br>73.01<br>ar) =Sum(2<br>0  | 197.94<br>211.93<br>211) <sub>15.1012</sub><br>0   | 322.65<br>345.45<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }<br>(215)m= 0 0<br>Water heating<br>Output from water h<br>165.55 144.<br>Efficiency of water h   | space heat         dary/supple         b       Mar         uirement (0         06       144.31         (204)]       } x         97       154.51         (secondat         x       100 ÷ (20         0         eater (calc         31       150.46         neater   | main system<br>lementar<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>08)<br>0<br>culated a<br>133.45   | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0<br>129.2         | Jun           0           0           0           113.79      | n, %<br>Jul<br>0<br>0                   | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54         | 02) × [1-<br>Sep<br>0<br>0<br>I (kWh/yea<br>122.88         | Oct<br>68.19<br>73.01<br>ar) = Sum(2)<br>0<br>ar) = Sum(2)<br>139.92                    | 197.94<br>211.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>149.36          | 322.65<br>345.45<br>=<br>0<br>=                    | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }<br>(215)m= 0 0<br>Water heating<br>Output from water h<br>165.55 144.<br>Efficiency of water h<br>(217)m= 86.59 86   | space heat<br>dary/supple<br>b Mar<br>uirement ( $\frac{1}{204}$ )] } x $\frac{1}{204}$ )] } x $\frac{1}{204}$ )] } x $\frac{1}{204}$ )] } x $\frac{1}{204}$ )] } x $\frac{1}{204}$ )] } x $\frac{1}{204}$ )] $\frac{1}{204}$ )] $\frac{1}{204}$ )] } x $\frac{1}{204}$ )] \frac{1}{204})] $\frac{1}{204}$ )] \frac{1}{204})] \frac{1}{204} | main         system           Iementar         Apr           calculate         56.59           100 ÷ (20           60.59           ry), kWh/           0           culated a           133.45           83.06 | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0                  | 0<br>0  | n, %<br>Jul<br>0                        | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota                   | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea<br>0<br>I (kWh/yea | Oct<br>68.19<br>73.01<br>ar) = Sum(2)<br>0<br>ar) = Sum(2)                              | 197.94<br>211.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 322.65<br>345.45<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)]}<br>(215)m= 0 0<br>Water heating<br>Output from water h<br>165.55 144.<br>Efficiency of water h<br>(217)m= 86.59 86<br>Fuel for water heating                      | space heat         dary/supple         b       Mar         uirement (d)         06       144.31         (204)]       } x         97       154.51         (secondant         x       100 ÷ (20         0         eater (calc         01         150.46         neater         84.95         ng, kWh/m   | main systementar<br>Apr<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>08<br>0<br>culated a<br>133.45<br>83.06<br>onth   | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0<br>129.2         | Jun           0           0           0           113.79      | n, %<br>Jul<br>0<br>0                   | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54         | 02) × [1-<br>Sep<br>0<br>0<br>I (kWh/yea<br>122.88         | Oct<br>68.19<br>73.01<br>ar) = Sum(2)<br>0<br>ar) = Sum(2)<br>139.92                    | 197.94<br>211.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>149.36          | 322.65<br>345.45<br>=<br>0<br>=                    | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }<br>(215)m= 0 0<br>Water heating<br>Output from water h<br>165.55 144.<br>Efficiency of water h<br>(217)m= 86.59 86   | space heat<br>dary/supp<br>b Mar<br>uirement (0<br>06 144.31<br>(204)] } x<br>7 154.51<br>(secondat<br>x 100 ÷ (20<br>0<br>eater (calo<br>31 150.46<br>reater<br>84.95<br>ng, kWh/m<br>100 ÷ (217  | main systementar<br>Apr<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>08<br>0<br>culated a<br>133.45<br>83.06<br>onth   | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0<br>129.2         | Jun           0           0           0           113.79      | n, %<br>Jul<br>0<br>0                   | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54         | 02) × [1-<br>Sep<br>0<br>0<br>I (kWh/yea<br>122.88         | Oct<br>68.19<br>73.01<br>ar) = Sum(2)<br>0<br>ar) = Sum(2)<br>139.92                    | 197.94<br>211.93<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>149.36          | 322.65<br>345.45<br>=<br>0<br>=                    | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Efficiency of main<br>Efficiency of secon<br>Jan Fe<br>Space heating req<br>307.73 211.<br>(211)m = {[(98)m x<br>329.47 225.<br>Space heating fue<br>= {[(98)m x (201)] }<br>(215)m= 0 0<br>Water heating<br>Output from water h<br>165.55 144.<br>Efficiency of water h<br>(217)m= 86.59 86<br>Fuel for water heating<br>(219)m = (64)m x | space heat<br>dary/supp<br>b Mar<br>uirement (0<br>06 144.31<br>(204)] } x<br>7 154.51<br>(secondat<br>x 100 ÷ (20<br>0<br>eater (calo<br>31 150.46<br>reater<br>84.95<br>ng, kWh/m<br>100 ÷ (217  | main system<br>lementar<br>calculate<br>56.59<br>100 ÷ (20<br>60.59<br>ry), kWh/<br>08)<br>0<br>culated a<br>133.45<br>83.06<br>onth<br>)m  | stem 1<br>em 1<br>y heating<br>d above)<br>14.24<br>06)<br>15.24<br>(month<br>0<br>129.2<br>81.2 | Jun         0         0         0         113.79         80.3 | n, %<br>Jul<br>0<br>0<br>109.02<br>80.3 | (204) = (2<br>Aug<br>0<br>Tota<br>0<br>Tota<br>121.54<br>80.3 | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea<br>122.88<br>80.3  | Oct<br>68.19<br>73.01<br>ar) = Sum(2)<br>0<br>ar) = Sum(2)<br>139.92<br>83.35<br>167.87 | 197.94<br>211.93<br>211) <sub>15.1012</sub><br>0<br>215) <sub>15.1012</sub><br>149.36<br>85.76 | 322.65<br>345.45<br>=<br>0<br>=<br>161.66<br>86.76 | 1<br>93.4<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |

| Annual totals                                     |                                 | kWh/year                    | г        | kWh/year                       | 1      |
|---|---------------------------------|-----------------------------|----------|--------------------------------|--------|
| Space heating fuel used, main system 1            |                                 |                             |          | 1416.18                        |        |
| Water heating fuel used                           |                                 |                             | [        | 1966.45                        |        |
| Electricity for pumps, fans and electric keep-hot |                                 |                             |          |                                |        |
| central heating pump:                             |                                 | [                           | 30       |                                | (230c) |
| boiler with a fan-assisted flue                   |                                 | [                           | 45       |                                | (230e) |
| Total electricity for the above, kWh/year         | sum of (230a)                   | (230g) =                    | [        | 75                             | (231)  |
| Electricity for lighting                          |                                 |                             | [        | 238.76                         | (232)  |
| 12a. CO2 emissions – Individual heating systems   | including micro-CHP             |                             |          |                                |        |
|   | <b>Energy</b><br>kWh/year       | Emission fact<br>kg CO2/kWh | or       | <b>Emissions</b><br>kg CO2/yea | r      |
| Space heating (main system 1)                     | (211) x                         | 0.216                       | = [      | 305.89                         | (261)  |
| Space heating (secondary)                         | (215) x                         | 0.519                       | = [      | 0                              | (263)  |
| Water heating                                     | (219) x                         | 0.216                       | = [      | 424.75                         | (264)  |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                             | [        | 730.65                         | (265)  |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519                       | =        | 38.93                          | (267)  |
| Electricity for lighting                          | (232) x                         | 0.519                       | = [      | 123.92                         | (268)  |
| Total CO2, kg/year                                | sum                             | of (265)(271) =             | ] [<br>[ | 893.49                         | (272)  |
|   |                                 |                             | L        |                                | I      |

|   |  |                          | User D     | etails:                      |             |             |                       |                   |                                       |                     |
|---|--|--------------------------|------------|------------------------------|-------------|-------------|-----------------------|-------------------|---------------------------------------|---------------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 201  |                          |            | Stroma<br>Softwa<br>Address: | re Ver      |             |                       | Versio            | n: 1.0.4.23                           |                     |
| Address :   | 2 Bed Flat, 219-223                                      |                          |            |                              |             | nh Junct    | tion. LON             | NDON              |                                       |                     |
| 1. Overall dwelling dime  |  |                          |            |                              |             | ,           | ,                     |                   |                                       |                     |
| Ground floor  |  |                          | Area<br>8  |                              | (1a) x      | <b></b>     | <b>ight(m)</b><br>2.5 | (2a) =            | <b>Volume(m<sup>3</sup></b><br>211.75 | <b>)</b><br>(3a)    |
| Total floor area TFA = (1   | a)+(1b)+(1c)+(1d)+(1e                                    | e)+(1n)                  | 8          | 34.7                         | (4)         |             |                       |                   |                                       |                     |
| Dwelling volume   |  |                          |            |                              | (3a)+(3b)   | +(3c)+(3c   | d)+(3e)+              | .(3n) =           | 211.75                                | (5)                 |
| 2. Ventilation rate:  |  |                          |            |                              |             |             |                       |                   |                                       |                     |
| Number of chimneys  | main s<br>heating h                                      | econdary<br>neating<br>0 | +          | other<br>0                   | ] = [       | total<br>0  | X 4                   | 40 =              | m <sup>3</sup> per hou                | r<br>(6a)           |
| Number of open flues  | 0 +  | 0                        | +          | 0                            | =           | 0           | ×2                    | 20 =              | 0                                     | (6b)                |
| Number of intermittent fa   | ins  |                          |            |                              | Γ           | 3           | Х ′                   | 10 =              | 30                                    | (7a)                |
| Number of passive vents   | ;  |                          |            |                              | Ē           | 0           | x ′                   | 10 =              | 0                                     | (7b)                |
| Number of flueless gas fi   | ires   |                          |            |                              | Ē           | 0           | X 4                   | 40 =              | 0                                     | (7c)                |
| Infiltration due to chimne  | ys, flues and fans = (6                                  | a)+(6b)+(7a              | ı)+(7b)+(7 | 7c) =                        | Г           | 30          |                       | Air ch<br>÷ (5) = | anges per ho                          | our                 |
| <i>If a pressurisation test has b</i><br>Number of storeys in th<br>Additional infiltration<br>Structural infiltration: 0 | ne dwelling (ns)   | ed, proceed              | to (17), c | otherwise c                  |             | om (9) to ( | (16)                  | -1]x0.1 =         | 0                                     | (9)<br>(10)<br>(11) |
|   | resent, use the value corres<br>ngs); if equal user 0.35 | sponding to t            | the greate | er wall area                 | a (after    |             |                       |                   | 0                                     | (12)                |
| If no draught lobby, en   | ter 0.05, else enter 0                                   |                          |            | ,                            |             |             |                       |                   | 0                                     | (13)                |
| Percentage of windows   | s and doors draught s                                    | tripped                  |            |                              |             |             |                       |                   | 0                                     | (14)                |
| Window infiltration   |  |                          |            | 0.25 - [0.2                  | x (14) ÷ 1  | = [00       |                       |                   | 0                                     | (15)                |
| Infiltration rate   |  |                          |            | (8) + (10) -                 | + (11) + (1 | 2) + (13) - | + (15) =              |                   | 0                                     | (16)                |
| Air permeability value,   | • •  |                          | •          | •                            |             | etre of e   | envelope              | area              | 5                                     | (17)                |
| If based on air permeabil   | •  |                          |            |                              |             |             |                       |                   | 0.39                                  | (18)                |
| Air permeability value applie<br>Number of sides sheltere   |  | s been done              | e or a deg | ree air pei                  | meability   | is being u  | sed                   | ĺ                 | 2                                     |                     |
| Shelter factor  | 0  |                          |            | (20) = 1 - [                 | 0.075 x (1  | 9)] =       |                       |                   | 0                                     | (19)<br>(20)        |
| Infiltration rate incorporat  | ting shelter factor                                      |                          |            | (21) = (18)                  | x (20) =    |             |                       |                   | 0.39                                  | (21)                |
| Infiltration rate modified f  | -  | d                        |            |                              |             |             |                       |                   | 0.00                                  |                     |
| Jan Feb   | Mar Apr May  | Jun                      | Jul        | Aug                          | Sep         | Oct         | Nov                   | Dec               |                                       |                     |
| Monthly average wind sp   | beed from Table 7  |                          |            |                              |             |             |                       |                   |                                       |                     |
| (22)m= 5.1 5  | 4.9 4.4 4.3  | 3.8                      | 3.8        | 3.7                          | 4           | 4.3         | 4.5                   | 4.7               |                                       |                     |
| Wind Factor (22a)m = (2   | 2)m ÷ 4  | ι Ι.                     |            |                              |             |             |                       |                   | I                                     |                     |
|   | 1.23 1.1 1.08  | 0.95                     | 0.95       | 0.92                         | 1           | 1.08        | 1.12                  | 1.18              |                                       |                     |
|   |  |                          |            |                              |             |             |                       |                   |                                       |                     |

| Adjuste  | ed infiltr   | ation rat   | e (allowi                             | ng for sh                                | nelter an  | d wind s   | peed) =  | (21a) x  | (22a)m   |  |                       |                     | _      |   |
|--|--|---|---------------------------------------|--|------------|--|--|--|--|--|-----------------------|---------------------|--------|---|
|  | 0.5  | 0.49  | 0.48                                  | 0.43                                     | 0.42       | 0.37   | 0.37   | 0.36   | 0.39   | 0.42   | 0.44                  | 0.46                |        |   |
|  |  | c <i>tive air</i><br>al ventila   | -                                     | rate for t                               | he appli   | cable ca   | se   |  |  |  |                       |                     |        | (23a)   |
|  |  |   |                                       | endix N. (2                              | 3b) = (23a | a) × Fmv (e  | equation (   | N5)) . othe  | rwise (23b   | ) = (23a)  |                       |                     | 0      |   |
|  |  |   |                                       |  |            | or in-use fa   |  |  |  | (200)  |                       |                     | 0      |   |
|  |  |   | -                                     | -  | -          |  |  |  |  | 2b)m + (1  | 23h) v [ <sup>,</sup> | 1 – (23c)           |        | (230)   |
| (24a)m=  | 0  |   |                                       | 0  | 0          | 0  | 0  |  |  |  | 0                     |                     | ]      | (24a)   |
|  | balance  | l<br>d mecha  | I<br>anical ve                        | entilation                               | without    | heat rec   | coverv (I  | I<br>/IV) (24b   | m = (22)   | 1<br>2b)m + (2   | L<br>23b)             |                     | J      |   |
| (24b)m=  | 0  | 0   | 0                                     | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0                     | 0                   | 1      | (24b)   |
| c) If v  | whole h  | u<br>ouse ex  | r<br>tract ver                        | ntilation of                             | or positiv | ve input v   | ventilatio   | n from c   | utside   |  |                       | <b></b>             | 1      |   |
| ,  |  |   |                                       |  | •          | •  |  |  |  | .5 × (23b  | )                     |                     |        |   |
| (24c)m=  | 0  | 0   | 0                                     | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0                     | 0                   | ]      | (24c)   |
| ,  |  |   |                                       |  | •          | /e input   |  |  |  |  |                       |                     |        |   |
| r  | · ,  |   | r <u>, ,</u>                          | r ·                                      | <i>.</i>   | erwise (2  | · ·  |  | r  | -<br>-   |                       |                     | 1      |   |
| (24d)m=  | 0.62   | 0.62  | 0.62                                  | 0.59                                     | 0.59       | 0.57   | 0.57   | 0.57   | 0.58   | 0.59   | 0.6                   | 0.61                | J      | (24d)   |
| r  |  | <u> </u>  |                                       | · ·                                      | , <u>,</u> | o) or (240   | , <u>,</u>   | <u>,                                     </u>  |  | 0.50   |                       | 0.04                | 1      | (25)  |
| (25)m=   | 0.62   | 0.62  | 0.62                                  | 0.59                                     | 0.59       | 0.57   | 0.57   | 0.57   | 0.58   | 0.59   | 0.6                   | 0.61                | J      | (25)  |
| 3. Hea   | at l <mark>osse</mark>   | s and he  | eat loss                              | paramete                                 | er:        |  |  |  |  |  |                       |                     |        |   |
| ELEN   | IE <mark>NT</mark>   | Gros  |                                       | Openin                                   |            | Net Ar   |  | U-valu   |  | AXU  |                       | k-value             |        | A X k   |
|  |  | alea  | (m²)                                  | m  | 2          | A,n  | n²   | W/m2   | 2K   | (VV/ł  | ()                    | kJ/m².              | K      | kJ/K  |
| Windov   | ws Type  |   | (m²)                                  | m  | 12         | A ,n   |  | W/m2<br>/[1/( 1.4 )+   |  | (W/ł<br>7.93   | <)                    | kJ/m²-              | К      | kJ/K<br>(27)  |
|  | ws Type<br>ws Type   | e 1   | (m²)                                  | m  | 12         | · · ·  | x1   |  | 0.04] =  | `  | <)                    | kJ/m <sup>2</sup> · | K      |   |
| Window   |  | e 1<br>e 2  | (m²)                                  | m  | 2          | 5.98   | x1   | /[1/( 1.4 )+   | 0.04] =<br>0.04] =   | 7.93   | <)                    | kJ/m²-              | K      | (27)  |
| Window<br>Window   | ws Type  | e 1<br>e 2<br>e 3   | (m²)                                  | m  | 2          | 5.98<br>0.86   | x1<br>x1<br>x1   | /[1/( 1.4 )+<br>/[1/( 1.4 )+   | 0.04] = [<br>0.04] = [<br>0.04] = [  | 7.93<br>1.14   |                       | kJ/m²-              | ĸ      | (27)<br>(27)  |
| Windov<br>Windov<br>Windov   | ws Type<br>ws Type   | e 1<br>e 2<br>e 3<br>e 4  | (m²)                                  | m  |            | 5.98<br>0.86<br>7.4  | x1<br>x1<br>x1<br>x1<br>x1   | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+   | 0.04] =<br>0.04] =<br>0.04] =<br>0.04] =   | 7.93<br>1.14<br>9.81   |                       | kJ/m²-I             | ĸ      | (27)<br>(27)<br>(27)  |
| Windov<br>Windov<br>Windov   | ws Type<br>ws Type<br>ws Type<br>ws Type   | e 1<br>e 2<br>e 3<br>e 4  |                                       |  |            | 5.98<br>0.86<br>7.4<br>4.83  | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1   | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+   | 0.04] =<br>0.04] =<br>0.04] =<br>0.04] =   | 7.93<br>1.14<br>9.81<br>6.4  |                       | kJ/m²-I             | K<br>T | (27)<br>(27)<br>(27)<br>(27)<br>(27)  |
| Windov<br>Windov<br>Windov<br>Windov   | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1  | <ul> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> </ul>  |                                       | 5.98                                     |            | 5.98<br>0.86<br>7.4<br>4.83<br>2.11<br>21.02   | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x2<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1 | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18   | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [  | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78   |                       | kJ/m²+              |        | (27)<br>(27)<br>(27)<br>(27)<br>(27)<br>(29)  |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T   | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2   | e 1<br>e 2<br>e 3<br>e 4<br>e 5<br><u>27</u><br><u>32.</u>  | 5                                     | 5.98                                     |            | 5.98<br>0.86<br>7.4<br>4.83<br>2.11<br>21.02<br>31.64  | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x<br>x   | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18   | $\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \end{array}$                            | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7                                  |                       | kJ/m²-              |        | (27)<br>(27)<br>(27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)                                |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T<br>Walls T  | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2<br>Type3  | <ul> <li>2</li> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> <li>32.4</li> <li>14.4</li> </ul>   | 555                                   | 5.98<br>0.86<br>7.4                      |            | 5.98<br>0.86<br>7.4<br>4.83<br>2.11<br>21.02<br>31.64<br>7.1   | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x<br>x<br>x<br>x<br>x<br>x   | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18                                 | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [   | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28                          |                       | kJ/m²-              |        | (27)<br>(27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)                                |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T<br>Walls T<br>Walls T   | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2<br>Type3<br>Type4   | <ul> <li>2</li> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> <li>32.3</li> <li>14.3</li> <li>22</li> </ul>   | 5 5 2                                 | 5.98<br>0.86<br>7.4<br>2.11              |            | 5.98<br>0.86<br>7.4<br>4.83<br>2.11<br>21.02<br>31.64<br>7.1<br>19.89  | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x  | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18<br>0.18         | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>= [<br>= [<br>= [   | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28<br>3.58                  |                       | kJ/m²+              |        | (27)<br>(27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)<br>(29)                        |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Walls T  | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2<br>Type3<br>Type4   | <ul> <li>1</li> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> <li>32.3</li> <li>14.4</li> <li>22</li> <li>9</li> </ul>  | 5                                     | 5.98<br>0.86<br>7.4<br>2.11<br>4.83      |            | 5.98<br>0.86<br>7.4<br>4.83<br>2.11<br>21.02<br>31.64<br>7.1<br>19.89<br>4.17  | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x  | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18<br>0.18<br>0.18                 | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [  | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28<br>3.58<br>0.75          |                       | kJ/m²-              |        | (27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)                |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Roof  | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2<br>Type3<br>Type5   | <ul> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> <li>32.4</li> <li>14.4</li> <li>22</li> <li>9</li> <li>84.5</li> </ul>   | 5552                                  | 5.98<br>0.86<br>7.4<br>2.11              |            | 5.98<br>0.86<br>7.4<br>4.83<br>2.11<br>21.02<br>31.64<br>7.1<br>19.89<br>4.17<br>84.7  | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x<br>x<br>x<br>x<br>x<br>x<br>x<br>x<br>x  | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18<br>0.18         | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>= [<br>= [<br>= [   | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28<br>3.58                  |                       | kJ/m²-              |        | (27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29 |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Roof<br>Total a   | ws Type<br>ws Type<br>ws Type<br>rype1<br>rype2<br>rype3<br>rype4<br>rype5<br>rea of e   | <ul> <li>1</li> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> <li>32.3</li> <li>14.4</li> <li>22</li> <li>9</li> </ul>  | 5552                                  | 5.98<br>0.86<br>7.4<br>2.11<br>4.83      |            | 5.98<br>0.86<br>7.4<br>4.83<br>2.11<br>21.02<br>31.64<br>7.1<br>19.89<br>4.17<br>84.7  | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x<br>x<br>x<br>x<br>x<br>x<br>x<br>x<br>x  | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18<br>0.18<br>0.18<br>0.18         | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [  | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28<br>3.58<br>0.75<br>11.01 |                       | kJ/m²+              |        | (27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29 |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Roof<br>Total a<br>Party w   | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2<br>Type3<br>Type5<br>rea of e<br>vall                                 | <ul> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> <li>32.4</li> <li>14.4</li> <li>22</li> <li>9</li> <li>84.5</li> </ul>   | 5552                                  | 5.98<br>0.86<br>7.4<br>2.11<br>4.83      |            | 5.98           0.86           7.4           4.83           2.11           21.02           31.64           7.1           19.89           4.17           84.7           189.7           17.5                                       | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x<br>x<br>x<br>x<br>x<br>x<br>x<br>x<br>x  | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18<br>0.18<br>0.18                 | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [  | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28<br>3.58<br>0.75          |                       | kJ/m²+              |        | (27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29 |
| Windov<br>Windov<br>Windov<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Roof<br>Total a<br>Party w<br>Party fl                            | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2<br>Type3<br>Type5<br>rea of e<br>wall<br>oor                          | <ul> <li>1</li> <li>2</li> <li>3</li> <li>4</li> <li>5</li> <li>27</li> <li>32.4</li> <li>14.3</li> <li>22</li> <li>9</li> <li>84.7</li> </ul>  | 5552                                  | 5.98<br>0.86<br>7.4<br>2.11<br>4.83      |            | 5.98           0.86           7.4           4.83           2.11           21.02           31.64           7.1           19.89           4.17           84.7           189.7           17.5           84.7                        |  | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18<br>0.18<br>0.18<br>0.18<br>0.13                 | 0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [<br>0.04] = [  | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28<br>3.58<br>0.75<br>11.01 |                       | kJ/m²-              |        | (27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29 |
| Window<br>Window<br>Window<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Walls T<br>Roof<br>Total a<br>Party w<br>Party fl<br>Interna<br>* for window | ws Type<br>ws Type<br>ws Type<br>ws Type<br>Type1<br>Type2<br>Type3<br>Type5<br>rea of e<br>vall<br>oor<br>I wall **<br>dows and | <ul> <li>a 1</li> <li>b 2</li> <li>c 3</li> <li>c 4</li> <li>c 5</li> <li>c 27</li> <li>c 32.4</li> <li>c 4</li> <li>c 27</li> <li>c 32.4</li> <li>c 14.4</li> <li>c 22</li> <li>c 9</li> <li>c 84.7</li> </ul> | 5<br>5<br>7<br>7<br>5, m <sup>2</sup> | 5.98<br>0.86<br>7.4<br>2.11<br>4.83<br>0 | ndow U-ve  | 5.98           0.86           7.4           4.83           2.11           21.02           31.64           7.1           19.89           4.17           84.7           17.5           84.7           126.5           alue calcula | x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x1<br>x<br>x<br>x<br>x<br>x<br>x<br>x<br>x                                       | /[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>/[1/( 1.4 )+<br>0.18<br>0.18<br>0.18<br>0.18<br>0.18<br>0.13 | 0.04] = [<br>0.04] = [ | 7.93<br>1.14<br>9.81<br>6.4<br>2.8<br>3.78<br>5.7<br>1.28<br>3.58<br>0.75<br>11.01 |                       |                     |        | (27)<br>(27)<br>(27)<br>(27)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29)<br>(29 |

| Fabric heat loss, $W/K = S (A \times U)$                                     | (26)(30) + (32) =                                 | 54.18   | (33) |
|--|---|---------|------|
| Heat capacity $Cm = S(A \times k)$   | ((28)(30) + (32) + (32a)(32e) =                   | 14800.8 | (34) |
| Thermal mass parameter (TMP = Cm $\div$ TFA) in kJ/m <sup>2</sup> K          | Indicative Value: Medium                          | 250     | (35) |
| For design assessments where the details of the construction are not known p | recisely the indicative values of TMP in Table 1f |         | _    |

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| can be ι   | ised inste | ad of a dei | tailed calc | ulation.                              |                |             |            |                   |            |                        |                                       |           |         |          |
|------------|------------|-------------|-------------|---------------------------------------|----------------|-------------|------------|-------------------|------------|------------------------|---------------------------------------|-----------|---------|----------|
| Therm      | al bridge  | es : S (L   | x Y) cal    | culated u                             | using Ap       | pendix ł    | <          |                   |            |                        |                                       |           | 8.13    | (36)     |
| if details | of therma  | al bridging | are not kri | own (36) =                            | = 0.05 x (3    | 1)          |            |                   |            |                        |                                       |           |         |          |
| Total fa   | abric he   | at loss     |             |                                       |                |             |            |                   | (33) +     | (36) =                 |                                       |           | 62.31   | (37)     |
| Ventila    | tion hea   | at loss ca  | alculated   | monthly                               | /              |             |            |                   | (38)m      | = 0.33 × (             | 25)m x (5)                            |           |         |          |
|            | Jan        | Feb         | Mar         | Apr                                   | May            | Jun         | Jul        | Aug               | Sep        | Oct                    | Nov                                   | Dec       |         |          |
| (38)m=     | 43.65      | 43.31       | 42.98       | 41.42                                 | 41.13          | 39.78       | 39.78      | 39.52             | 40.3       | 41.13                  | 41.72                                 | 42.34     |         | (38)     |
| Heat tr    | ansfer o   | coefficier  | nt, W/K     |                                       |                |             |            |                   | (39)m      | = (37) + (3            | 38)m                                  |           |         |          |
| (39)m=     | 105.96     | 105.63      | 105.29      | 103.74                                | 103.45         | 102.09      | 102.09     | 101.84            | 102.61     | 103.45                 | 104.04                                | 104.65    |         |          |
|            |            | motor (F    | יאי ים ור   | /m2k                                  |                |             |            |                   |            | Average =<br>= (39)m ÷ | Sum(39) <sub>1</sub>                  | .12 /12=  | 103.74  | (39)     |
| (40)m=     | 1.25       | meter (H    | 1.24        | 1.22                                  | 1.22           | 1.21        | 1.21       | 1.2               | 1.21       | - ( <del>33)</del> m ÷ | (+)                                   | 1.24      |         |          |
| (40)m=     | 1.20       | 1.25        | 1.24        | 1.22                                  | 1.22           | 1.21        | 1.21       | 1.2               |            |                        |                                       |           | 1.00    | (40)     |
| Numbe      | er of day  | vs in mor   | nth (Tab    | le 1a)                                |                |             |            |                   | +          | <pre>average =</pre>   | Sum(40)1                              | .12 / 12= | 1.22    | (40)     |
|            | Jan        | Feb         | Mar         | Apr                                   | May            | Jun         | Jul        | Aug               | Sep        | Oct                    | Nov                                   | Dec       |         |          |
| (41)m=     | 31         | 28          | 31          | 30                                    | 31             | 30          | 31         | 31                | 30         | 31                     | 30                                    | 31        |         | (41)     |
|            |            |             |             |                                       |                |             |            |                   |            |                        |                                       |           |         |          |
| 4. Wa      | iter heat  | ting ener   | rav reau    | irement:                              |                |             |            |                   |            |                        |                                       | kWh/ye    | ear:    |          |
|            |            |             |             |                                       |                |             |            |                   |            |                        |                                       |           | 1       |          |
|            |            | ipancy, I   |             | [1 - ovo                              | (_0_0003       |             | -13 0      | )2)] + 0.0        | )013 v (T  | FEA -13                |                                       | 55        |         | (42)     |
|            | A £ 13.9   |             | T 1.70 X    | [i - evh                              | (-0.0003       | 49 X (11    | A - 13.9   | )2)] + 0.0        | 013 x (1   | п д -13.               | 5)                                    |           |         |          |
|            |            |             |             |                                       |                |             |            | (25 x N)          |            |                        |                                       | .67       |         | (43)     |
|            |            |             |             | usage by {<br><sup>•</sup> day (all w |                |             |            | to achieve        | a water us | se target o            | f                                     |           |         |          |
| normore    |            |             |             |                                       |                |             |            |                   |            |                        |                                       |           |         |          |
| 11-4-1     | Jan        | Feb         | Mar         | Apr                                   | May            | Jun         | Jul        | Aug               | Sep        | Oct                    | Nov                                   | Dec       |         |          |
| HOT WATE   | -          |             | aay tor ea  | ach month                             | va,m = Tai     | ctor from 1 |            | (43)              |            |                        |                                       |           |         |          |
| (44)m=     | 104.13     | 100.35      | 96.56       | 92.77                                 | 88.99          | 85.2        | 85.2       | 88.99             | 92.77      | 96.56                  | 100.35                                | 104.13    |         | <b>-</b> |
| Energy o   | content of | hot water   | used - cal  | culated mo                            | onthly $= 4$ . | 190 x Vd,n  | n x nm x D | )Tm / 3600        |            |                        | m(44) <sub>112</sub> =<br>ables 1b, 1 |           | 1136.02 | (44)     |
| (45)m=     | 154.43     | 135.06      | 139.37      | 121.51                                | 116.59         | 100.61      | 93.23      | 106.98            | 108.26     | 126.17                 | 137.72                                | 149.56    |         |          |
|            |            |             |             |                                       |                |             |            |                   |            | Fotal = Su             | m(45) <sub>112</sub> =                | :         | 1489.5  | (45)     |
| lf instant | taneous w  | ater heatii | ng at point | of use (no                            | hot water      | storage),   | enter 0 in | boxes (46)        | ) to (61)  |                        |                                       |           |         |          |
| (46)m=     | 23.16      | 20.26       | 20.91       | 18.23                                 | 17.49          | 15.09       | 13.98      | 16.05             | 16.24      | 18.93                  | 20.66                                 | 22.43     |         | (46)     |
|            | storage    |             | الم ماريما  |                                       |                |             |            |                   |            | aal                    |                                       |           | I       |          |
| -          |            | . ,         |             |                                       |                |             | -          | within sa         | ime vess   | sei                    | (                                     | )         |         | (47)     |
|            | •          | •           |             | ink in dw                             | •              |             |            | (47)<br>mbi boile | are) onto  | or 'O' in (            | 47)                                   |           |         |          |
|            | storage    |             | not wate    | 51 (1115 11                           |                | istantai    |            |                   | ers) ente  |                        | 47)                                   |           |         |          |
|            | -          |             | eclared I   | oss facto                             | or is kno      | wn (kWł     | n/day):    |                   |            |                        |                                       | )         |         | (48)     |
|            |            | actor fro   |             |                                       |                | ,           | ,          |                   |            |                        |                                       | )         |         | (49)     |
|            |            |             |             | , kWh/ye                              | ar             |             |            | (48) x (49)       | =          |                        |                                       | )         |         | (50)     |
|            |            |             | -           | cylinder l                            |                | or is not   |            |                   |            |                        | `                                     | ,         |         | (00)     |
|            |            |             |             | om Tabl                               |                |             |            |                   |            |                        | (                                     | )         |         | (51)     |
|            | •          | eating s    |             | on 4.3                                |                |             |            |                   |            |                        |                                       |           |         |          |
|            |            | from Tal    |             | 0                                     |                |             |            |                   |            |                        | (                                     | )         |         | (52)     |
| Tempe      | erature f  | actor fro   | m l'able    | 2b                                    |                |             |            |                   |            |                        | (                                     | )         |         | (53)     |

|          |            | m water<br>(54) in (5                 | -                | , kWh/ye         | ear        |             |             | (47) x (51)  | ) x (52) x ( | 53) =                     | 0                |             |               | (54)<br>(55) |
|----------|------------|---------------------------------------|------------------|------------------|------------|-------------|-------------|--------------|--------------|---------------------------|------------------|-------------|---------------|--------------|
|          |            | loss cal                              |                  | for each         | month      |             |             | ((56)m = (   | 55) × (41)r  | m                         | L                |             |               |              |
| (56)m=   | 0          | 0                                     | 0                | 0                | 0          | 0           | 0           | 0            | 0            | 0                         | 0                | 0           |               | (56)         |
|          | er contain | s dedicate                            | l<br>d solar sto | l<br>rage, (57)ı | n = (56)m  | x [(50) – ( | H11)] ÷ (5  | 0), else (5  | 7)m = (56)   | m where (                 | I<br>H11) is fro | m Append    | l<br>lix H    |              |
| (57)m=   | 0          | 0                                     | 0                | 0                | 0          | 0           | 0           | 0            | 0            | 0                         | 0                | 0           |               | (57)         |
| Primar   | y circuit  | loss (ar                              | nual) fro        | om Table         | e 3        |             |             |              |              |                           |                  | 0           |               | (58)         |
| Primar   | y circuit  | loss cal                              | culated          | for each         | month (    | 59)m = (    | (58) ÷ 36   | 65 × (41)    | m            |                           |                  |             |               |              |
| •        |            | i                                     | i                | i                | i          | i           | i           | <u> </u>     | cylinde      |                           | <u> </u>         | ·           | 1             | ()           |
| (59)m=   | 0          | 0                                     | 0                | 0                | 0          | 0           | 0           | 0            | 0            | 0                         | 0                | 0           |               | (59)         |
| Combi    | loss ca    | lculated                              | for each         | month (          | (61)m =    | (60) ÷ 36   | 65 × (41)   | )m           |              |                           | -                | -           |               |              |
| (61)m=   | 50.96      | 46.03                                 | 49.21            | 45.75            | 45.35      | 42.02       | 43.42       | 45.35        | 45.75        | 49.21                     | 49.32            | 50.96       |               | (61)         |
| Total h  | neat req   | uired for                             | water h          | eating ca        | alculated  | for eac     | h month     | (62)m =      | 0.85 × (     | (45)m +                   | (46)m +          | (57)m +     | (59)m + (61)n | ۱            |
| (62)m=   | 205.39     | 181.09                                | 188.58           | 167.26           | 161.94     | 142.63      | 136.65      | 152.33       | 154.01       | 175.37                    | 187.04           | 200.51      |               | (62)         |
| Solar DI | HW input   | calculated                            | using App        | endix G oı       | · Appendix | H (negati   | ve quantity | v) (enter '0 | ' if no sola | r contribut               | ion to wate      | er heating) |               |              |
| (add a   | dditiona   | l lines if                            | FGHRS            | and/or \         | WHRS       | applies     | , see Ap    | pendix C     | G)           |                           |                  |             | 1             |              |
| (63)m=   | 0          | 0                                     | 0                | 0                | 0          | 0           | 0           | 0            | 0            | 0                         | 0                | 0           |               | (63)         |
| Output   | t from w   | ater hea                              | ter              | i                |            |             |             |              |              |                           |                  |             |               |              |
| (64)m=   | 205.39     | 181.09                                | 188.58           | 167.26           | 161.94     | 142.63      | 136.65      | 152.33       | 154.01       | 175.37                    | 187.04           | 200.51      |               | _            |
|          |            |                                       |                  |                  |            |             |             | Outp         | out from wa  | ater heate                | r (annual)₁      | 12          | 2052.8        | (64)         |
| Heat g   |            | m water                               | heating,         | kWh/m            | onth 0.2   | 5 [0.85     | × (45)m     | + (61)m      | n] + 0.8 x   | ( <mark>46)m</mark>       | + (57)m          | + (59)m     | ]             |              |
| (65)m=   | 64.09      | 56.42                                 | 58.64            | 51.84            | 50.1       | 43.96       | 41.85       | 46.91        | 47.43        | 54.25                     | 58.12            | 62.47       |               | (65)         |
| inclu    | ide (57)   | m in calo                             | culation         | of (65)m         | only if c  | ylinder i   | s in the o  | dwelling     | or hot w     | ate <mark>r is f</mark> r | om com           | munity h    | eating        |              |
| 5. Ini   | ternal ga  | ains (see                             | e Table §        | 5 and 5a         | ):         |             |             |              |              |                           |                  |             |               |              |
| Metab    | olic gair  | s (Table                              | 5), Wat          | ts               |            |             |             |              |              |                           | 1                | i           |               |              |
|          | Jan        | Feb                                   | Mar              | Apr              | May        | Jun         | Jul         | Aug          | Sep          | Oct                       | Nov              | Dec         |               |              |
| (66)m=   | 127.3      | 127.3                                 | 127.3            | 127.3            | 127.3      | 127.3       | 127.3       | 127.3        | 127.3        | 127.3                     | 127.3            | 127.3       |               | (66)         |
| Lightin  | g gains    | (calcula                              | · · · ·          | pendix           | L, equat   | ion L9 o    | r L9a), a   | lso see      | Table 5      | r                         | i                | i           |               |              |
| (67)m=   | 20.41      | 18.13                                 | 14.75            | 11.16            | 8.34       | 7.04        | 7.61        | 9.89         | 13.28        | 16.86                     | 19.68            | 20.98       |               | (67)         |
| Applia   | nces ga    | · · · · · · · · · · · · · · · · · · · | ulated ir        | Append           | dix L, eq  | uation L    | 13 or L1    | 3a), alsc    | see Tal      | ble 5                     | 1                |             | L             |              |
| (68)m=   | 228.98     | 231.36                                | 225.37           | 212.62           | 196.53     | 181.41      | 171.31      | 168.93       | 174.92       | 187.66                    | 203.76           | 218.88      |               | (68)         |
| Cookir   | ng gains   | (calcula                              | ted in A         | ppendix          | L, equat   | ion L15     | or L15a)    | , also se    | e Table      | 5                         |                  |             |               |              |
| (69)m=   | 35.73      | 35.73                                 | 35.73            | 35.73            | 35.73      | 35.73       | 35.73       | 35.73        | 35.73        | 35.73                     | 35.73            | 35.73       |               | (69)         |
| Pumps    | and fa     | ns gains                              | (Table &         | ōa)              |            |             |             |              |              |                           |                  |             |               |              |
| (70)m=   | 3          | 3                                     | 3                | 3                | 3          | 3           | 3           | 3            | 3            | 3                         | 3                | 3           |               | (70)         |
| Losses   | s e.g. ev  | aporatio                              | n (nega          | tive valu        | es) (Tab   | le 5)       |             |              |              |                           | -                | -           |               |              |
| (71)m=   | -101.84    | -101.84                               | -101.84          | -101.84          | -101.84    | -101.84     | -101.84     | -101.84      | -101.84      | -101.84                   | -101.84          | -101.84     |               | (71)         |
| Water    | heating    | gains (T                              | able 5)          |                  |            |             |             |              |              |                           |                  |             |               |              |
| (72)m=   | 86.14      | 83.95                                 | 78.82            | 72               | 67.34      | 61.05       | 56.25       | 63.05        | 65.88        | 72.92                     | 80.72            | 83.96       |               | (72)         |
| Total i  | nternal    | gains =                               |                  |                  |            | (66)        | m + (67)m   | ı + (68)m +  | + (69)m + (  | (70)m + (7                | 1)m + (72)       | m           |               |              |
| (73)m=   | 399.73     | 397.63                                | 383.13           | 359.98           | 336.41     | 313.7       | 299.36      | 306.06       | 318.27       | 341.64                    | 368.35           | 388.01      |               | (73)         |
| 6. So    | lar gains  | 5:                                    |                  |                  |            |             |             |              |              |                           |                  |             |               |              |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation:   | Access Factor<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a     |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|----------------|---------------------------|---|------------|---|----------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x | 0.77                      | x | 0.86       | × | 11.28                | x | 0.63           | x | 0.7            | = | 2.97         | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 22.97                | x | 0.63           | x | 0.7            | = | 6.04         | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 41.38                | x | 0.63           | x | 0.7            | = | 10.88        | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 67.96                | x | 0.63           | x | 0.7            | = | 17.86        | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 91.35                | x | 0.63           | x | 0.7            | = | 24.01        | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 97.38                | x | 0.63           | x | 0.7            | = | 25.6         | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 91.1                 | x | 0.63           | x | 0.7            | = | 23.94        | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 72.63                | x | 0.63           | x | 0.7            | = | 19.09        | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 50.42                | x | 0.63           | x | 0.7            | = | 13.25        | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 28.07                | x | 0.63           | x | 0.7            | = | 7.38         | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 14.2                 | x | 0.63           | x | 0.7            | = | 3.73         | (75) |
| Northeast 0.9x | 0.77                      | x | 0.86       | x | 9.21                 | x | 0.63           | x | 0.7            | = | 2.42         | (75) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 36.79                | x | 0.63           | x | 0.7            | = | 23.73        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 62.67                | x | 0.63           | x | 0.7            | = | 40.41        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 85.75                | x | 0.63           | x | 0.7            | = | 55.3         | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | × | 106.25               | х | 0.63           | x | 0.7            | = | 68.52        | (77) |
| Southeast 0.9  | 0.77                      | x | 2.11       | x | 119.01               | x | 0.63           | x | 0.7            | = | 76.74        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 118.15               | × | 0.63           | x | 0.7            | = | 76.19        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 113.91               | x | 0.63           | x | 0.7            | = | 73.45        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 104.3 <mark>9</mark> | x | 0.63           | x | 0.7            | = | 67.32        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 92 <mark>.85</mark>  | x | 0.63           | x | 0.7            | = | 59.87        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | × | 69.27                | x | 0.63           | x | 0.7            | = | 44.67        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 44.07                | x | 0.63           | x | 0.7            | = | 28.42        | (77) |
| Southeast 0.9x | 0.77                      | x | 2.11       | x | 31.49                | x | 0.63           | x | 0.7            | = | 20.3         | (77) |
| Southwest0.9x  | 0.77                      | x | 5.98       | x | 36.79                |   | 0.63           | x | 0.7            | = | 67.24        | (79) |
| Southwest0.9x  | 0.77                      | x | 5.98       | x | 62.67                |   | 0.63           | x | 0.7            | = | 114.54       | (79) |
| Southwest0.9x  | 0.77                      | x | 5.98       | x | 85.75                |   | 0.63           | x | 0.7            | = | 156.72       | (79) |
| Southwest0.9x  |                           | x | 5.98       | x | 106.25               |   | 0.63           | x | 0.7            | = | 194.18       | (79) |
| Southwest0.9x  | 0.77                      | x | 5.98       | × | 119.01               |   | 0.63           | x | 0.7            | = | 217.5        | (79) |
| Southwest0.9x  |                           | x | 5.98       | x | 118.15               |   | 0.63           | x | 0.7            | = | 215.93       | (79) |
| Southwest0.9x  |                           | x | 5.98       | x | 113.91               |   | 0.63           | x | 0.7            | = | 208.18       | (79) |
| Southwest0.9x  |                           | x | 5.98       | x | 104.39               |   | 0.63           | x | 0.7            | = | 190.78       | (79) |
| Southwest0.9x  |                           | x | 5.98       | x | 92.85                |   | 0.63           | x | 0.7            | = | 169.69       | (79) |
| Southwest0.9x  |                           | x | 5.98       | x | 69.27                |   | 0.63           | x | 0.7            | = | 126.59       | (79) |
| Southwest0.9x  |                           | x | 5.98       | x | 44.07                |   | 0.63           | x | 0.7            | = | 80.54        | (79) |
| Southwest0.9x  | 0.77                      | x | 5.98       | × | 31.49                |   | 0.63           | x | 0.7            | = | 57.55        | (79) |
| West 0.9x      |                           | x | 4.83       | × | 19.64                | x | 0.63           | x | 0.7            | = | 28.99        | (80) |
| West 0.9x      | 0.77                      | x | 4.83       | × | 38.42                | x | 0.63           | x | 0.7            | = | 56.71        | (80) |
| West 0.9x      | 0.77                      | x | 4.83       | x | 63.27                | x | 0.63           | x | 0.7            | = | 93.4         | (80) |

|                            |   | -        |                  | -        |                 | -      |              |          |                |        |        | _    |
|----------------------------|---|----------|------------------|----------|-----------------|--------|--------------|----------|----------------|--------|--------|------|
| West 0.9x                  | 0.77  | ×        | 4.83             | ×        | 92.28           | X      | 0.63         | ×        | 0.7            | =      | 136.22 | (80) |
| West 0.9x                  | 0.77  | ×        | 4.83             | ×        | 113.09          | ×      | 0.63         | ×        | 0.7            | =      | 166.94 | (80) |
| West 0.9x                  | 0.77  | ×        | 4.83             | ×        | 115.77          | ×      | 0.63         | ×        | 0.7            | =      | 170.89 | (80) |
| West 0.9x                  | 0.77  | x        | 4.83             | ×        | 110.22          | x      | 0.63         | ×        | 0.7            | =      | 162.69 | (80) |
| West 0.9x                  | 0.77  | X        | 4.83             | x        | 94.68           | x      | 0.63         | x        | 0.7            | =      | 139.75 | (80) |
| West 0.9x                  | 0.77  | x        | 4.83             | x        | 73.59           | x      | 0.63         | x        | 0.7            | =      | 108.63 | (80) |
| West 0.9x                  | 0.77  | x        | 4.83             | x        | 45.59           | x      | 0.63         | x        | 0.7            | =      | 67.29  | (80) |
| West 0.9x                  | 0.77  | x        | 4.83             | x        | 24.49           | x      | 0.63         | ×        | 0.7            | =      | 36.15  | (80) |
| West 0.9x                  | 0.77  | x        | 4.83             | x        | 16.15           | x      | 0.63         | x        | 0.7            | =      | 23.84  | (80) |
| Northwest 0.9x             | 0.77  | x        | 7.4              | ×        | 11.28           | x      | 0.63         | ×        | 0.7            | =      | 25.52  | (81) |
| Northwest 0.9x             | 0.77  | x        | 7.4              | x        | 22.97           | x      | 0.63         | x        | 0.7            | =      | 51.94  | (81) |
| Northwest 0.9x             | 0.77  | x        | 7.4              | x        | 41.38           | x      | 0.63         | x        | 0.7            | =      | 93.58  | (81) |
| Northwest 0.9x             | 0.77  | x        | 7.4              | ] ×      | 67.96           | x      | 0.63         | ×        | 0.7            | =      | 153.68 | (81) |
| Northwest 0.9x             | 0.77  | x        | 7.4              | ×        | 91.35           | x      | 0.63         | x        | 0.7            | =      | 206.58 | (81) |
| Northwest 0.9x             | 0.77  | x        | 7.4              | ×        | 97.38           | x      | 0.63         | ×        | 0.7            | =      | 220.24 | (81) |
| Northwest 0.9x             | 0.77  | ×        | 7.4              | X        | 91.1            | x      | 0.63         | - x      | 0.7            | =      | 206.03 | (81) |
| Northwest 0.9x             | 0.77  | x        | 7.4              | Ī×       | 72.63           | x      | 0.63         | ×        | 0.7            | =      | 164.25 | (81) |
| Northwest 0.9x             | 0.77  | ×        | 7.4              | X        | 50.42           | x      | 0.63         | x        | 0.7            | =      | 114.03 | (81) |
| Northwest 0.9x             | 0.77  | ے<br>x آ | 7.4              | j x      | 28.07           | x      | 0.63         | x        | 0.7            |        | 63.47  | (81) |
| Northwest 0.9x             | 0.77  | -<br>X   | 7.4              | x        | 14.2            | i 人    | 0.63         | x        | 0.7            | =      | 32.11  | (81) |
| Northwest 0.9x             | 0.77  | ×        | 7.4              | İ x      | 9.21            | x      | 0.63         | x        | 0.7            | =      | 20.84  | (81) |
|                            |   |          |                  |          |                 | -      |              | -        |                |        |        |      |
| Solar gains in             | watts, calcu                                  | lated    | for each mon     | th       |                 | (83)m  | n = Sum(74)m | .(82)m   |                |        |        |      |
| (83)m= 148.44              | 269.64 40                                     | 9.87     | 570.46 691.7     | 7 7      | 08.84 674.3     | 581    | .18 465.47   | 309.4    | 180.95         | 124.95 |        | (83) |
| Total gains –              | nternal and                                   | solar    | (84)m = (73)r    | n + (    | 83)m , watts    |        |              |          |                |        |        |      |
| <mark>(84)m=</mark> 548.17 | 667.28 7                                      | 93       | 930.44 1028.     | 18 1     | 022.54 973.66   | 887    | .25 783.74   | 651.04   | 549.3          | 512.96 |        | (84) |
| 7. Mean inte               | rnal tempera                                  | iture (  | heating seas     | on)      |                 |        |              |          |                |        |        |      |
| Temperature                | during heat                                   | ing pe   | eriods in the li | ving     | area from Tal   | ble 9  | , Th1 (°C)   |          |                |        | 21     | (85) |
| Utilisation fa             | ctor for gains                                | s for li | iving area, h1   | ,m (s    | ee Table 9a)    |        |              |          |                |        |        |      |
| Jan                        | Feb I   | Mar      | Apr Ma           | y        | Jun Jul         | A      | ug Sep       | Oct      | Nov            | Dec    |        |      |
| (86)m= 1                   | 0.99 0  | .98      | 0.92 0.8         |          | 0.61 0.46       | 0.5    | 52 0.78      | 0.96     | 0.99           | 1      |        | (86) |
| Mean interna               | I temperatu                                   | re in l  | iving area T1    | (follo   | ow steps 3 to 7 | 7 in T | able 9c)     |          |                |        |        |      |
| (87)m= 19.67               | <u>i i</u>                                    | ).18     | 20.57 20.8       | <u>`</u> | 20.97 20.99     | 20.    | <u> </u>     | 20.51    | 20.02          | 19.64  |        | (87) |
| Tamparatura                |   | ing n    | I                |          | ulling from To  |        |              |          |                |        |        |      |
| (88)m= 19.88               | <u>1                                     </u> | 9.89     | 19.9 19.9        | _        | velling from Ta | 19.    | <u> </u>     | 19.9     | 19.9           | 19.89  |        | (88) |
|                            | II  |          | I                |          | I               |        |              | 10.0     | 10.0           | 10.00  |        | ()   |
|                            | T T   |          |                  | _        | ,m (see Table   | T Ó    |              | 0.04     |                | 4      | l      | (20) |
| (89)m= 1                   | 0.99 0  | .97      | 0.9 0.74         |          | 0.52 0.35       | 0.4    | 4 0.7        | 0.94     | 0.99           | 1      |        | (89) |
|                            | r <sup>·</sup> r                              |          |                  |          | T2 (follow ste  | r –    | 1 1          |          |                |        | I      |      |
| (90)m= 18.12               | 18.41 18                                      | 8.86     | 19.41 19.76      | 6        | 19.9 19.91      | 19.    |              | 19.35    |                | 18.08  |        | (90) |
|                            |   |          |                  |          |                 |        | fl           | _A = Liv | ring area ÷ (4 | +) =   | 0.3    | (91) |

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$ 

|   |   |  |  |  |  |   | -                                       | _   |   | _   | _  |  |                                    |  |
|---|---|--|--|--|--|---|---|---|---|---|--|--|------------------------------------|--|
| (92)m=  | 18.59   | 18.85  | 19.26  | 19.76  | 20.09  | 20.22   | 20.24                                   | 20.24   | 20.16   | 19.7  | 19.06  | 18.56  |                                    | (92)   |
| Apply a   | adjustm   | nent to t  | he mear  | internal   | temper   | ature fro   | m Table                                 | 4e, whe   | ere appro   | opriate   | _  |  |                                    |  |
| (93)m=  | 18.59   | 18.85  | 19.26  | 19.76  | 20.09  | 20.22   | 20.24                                   | 20.24   | 20.16   | 19.7  | 19.06  | 18.56  |                                    | (93)   |
| 8. Spac   | ce heat   | ting requ  | uirement   |  |  |   |   |   |   |   |  |  |                                    |  |
|   |   |  |  | •  |  | ed at st  | ep 11 of                                | Table 9   | o, so tha   | t Ti,m=(  | 76)m an  | d re-calc  | culate                             |  |
| the utili   | isation   | factor fo  | or gains   | using Ta   | ble 9a   |   |   |   |   |   |  |  | I                                  |  |
|   | Jan   | Feb  | Mar  | Apr  | May  | Jun   | Jul                                     | Aug   | Sep   | Oct   | Nov  | Dec  |                                    |  |
| Utilisati   | ī   |  | ains, hm   | i  |  |   | 1                                       |   |   |   |  |  | I                                  |  |
| (94)m=  | 0.99  | 0.99   | 0.96   | 0.9  | 0.75   | 0.55  | 0.38                                    | 0.44  | 0.72  | 0.94  | 0.99   | 1  |                                    | (94)   |
| _   | <u> </u>  |  | · _ ` _  | 4)m x (84  | ,  |   |   | r   |   | r   | r  |  | 1                                  |  |
| (95)m=  | 545.21  | 658.46   | 764.72   | 833.48   | 771.86   | 557.97  | 369.56                                  | 386.91  | 564.72  | 612.1   | 543.02   | 510.9  |                                    | (95)   |
| Monthl  | y avera   | age exte   | rnal tem   | perature   | e from Ta  | able 8  |   |   |   |   |  |  | 1                                  |  |
| (96)m=  | 4.3   | 4.9  | 6.5  | 8.9  | 11.7   | 14.6  | 16.6                                    | 16.4  | 14.1  | 10.6  | 7.1  | 4.2  |                                    | (96)   |
|   |   |  | 1  | · · · ·  |  | Lm , W =  | =[(39)m :                               | x [(93)m  | – (96)m   | ]   | i  |  |                                    |  |
| (97)m= 1  | 1514.05   | 1473.86  | 1343.87  | 1126.94  | 867.98   | 573.89  | 371.74                                  | 391.06  | 621.46  | 941.21  | 1243.82  | 1502.35  |                                    | (97)   |
| Space   | heating   | g require  | ement fo   | r each m   | nonth, k\  | Nh/mon <sup>-</sup>   | th = 0.02                               | 24 x [(97                                       | )m – (95  | )m] x (4  | 1)m  |  | 1                                  |  |
| (98)m=  | 720.81  | 547.95   | 430.89   | 211.29   | 71.52  | 0   | 0                                       | 0   | 0   | 244.85  | 504.58   | 737.64   |                                    |  |
|   |   |  |  |  |  |   |   | Tota  | l per year  | (kWh/yeai   | ) = Sum(9  | 8)15,912 =   | 3469.53                            | (98)   |
| Space   | heating   | n require  | ement in   | kWh/m <sup>2</sup>   | /year  |   |   |   |   |   |  |  | 40.96                              | (99)   |
| 9a. Enei  |   |  |  |  |  | votomo i  | noluding                                |   | חחי   |   |  |  |                                    |  |
|   |   |  |  | iviuuai n  | eating s   | ystems i  |   |   |   |   |  |  |                                    |  |
| Space<br>Fraction   |   | •  | t from s   | econdar  | /supple  | mentary   | v system                                |   |   |   |  |  | 0                                  | (201)  |
|   |   |  |  |  |  | in or nearly  |   | (202) = 1                                       | (201) -   |   |  |  |                                    | (202)  |
|   | in or sp  | ace nea  | а попі п   | nain syst  | em(s)  |   |   | (202) - 1                                       | - (201) -   |   |  |  | 1                                  |  |
|   |   |  |  |  |  |   |   | (22.0) (2                                       |   | (0.00)7   |  |  |                                    |  |
| Fractio   | n of tot  | al heati   | ng from  | main sys   | stem 1   |   |   | (204) = (2                                      | 02) × [1 –  | (203)] =  |  |  | 1                                  | (204)  |
|   |   |  |  | main sys<br>ing syste  |  |   |   | (204) = (2                                      |   | (203)] =  |  |  |                                    |  |
| Efficien  | ncy of n  | nain spa   | ace heat   |  | em 1   | g system  |   | (204) = (2                                      |   | (203)] =  |  |  | 1                                  | (204)  |
| Efficien  | ncy of n<br>ncy of s  | nain spa<br>econda   | ace heat   | ing syste  | em 1<br>y heating  | g system<br>Jun   | n, %                                    |   | 02) × [1 –  | (203)] =<br>Oct   | Nov  | Dec  | 1<br>93.4<br>0                     | (204)<br>(206)<br>(208)  |
| Eff <mark>icien</mark><br>Efficien  | ncy of n<br>ncy of s<br>Jan   | nain spa<br>seconda<br>Feb   | ace heat<br>ry/suppl<br>Mar  | ing syste<br>ementar<br>Apr  | em 1<br>y heating<br>May   | Jun   |   | (204) = (2<br>Aug                               |   |   | Nov  | Dec  | 1<br>93.4                          | (204)<br>(206)<br>(208)  |
| Efficien<br>Efficien<br>Space   | ncy of n<br>ncy of s<br>Jan   | nain spa<br>seconda<br>Feb   | ace heat<br>ry/suppl<br>Mar  | ing syste  | em 1<br>y heating<br>May   | Jun   | n, %                                    |   | 02) × [1 –  |   | Nov<br>504.58  | Dec<br>737.64                                      | 1<br>93.4<br>0                     | (204)<br>(206)<br>(208)  |
| Efficien<br>Efficien<br>Space   | ncy of n<br>ncy of s<br>Jan<br>heating<br>720.81  | nain spa<br>seconda<br>Feb<br>g require<br>547.95  | ace heat<br>ry/supple<br>Mar<br>ement (c<br>430.89   | ing syste<br>ementary<br>Apr<br>alculated<br>211.29  | em 1<br>y heating<br>May<br>d above)<br>71.52  | Jun   | n, %<br>Jul                             | Aug   | 02) × [1 –<br>Sep   | Oct   | _  |  | 1<br>93.4<br>0                     | (204)<br>(206)<br>(208)<br>ear                                     |
| Efficien<br>Efficien<br>Space   | Decy of n<br>Decy of s<br>Jan<br>heating<br>720.81<br>= {[(98)  | Feb<br>g require<br>547.95   | ace heat<br>ry/supple<br>Mar<br>ement (c<br>430.89<br>(4)] } x 1   | Apr<br>211.29<br>00 ÷ (20  | em 1<br>y heating<br>May<br>d above)<br>71.52  | Jun<br>)<br>0   | n, %<br>Jul<br>0                        | Aug<br>0  | 02) × [1 –<br>Sep<br>0                                      | Oct<br>244.85   | 504.58   | 737.64   | 1<br>93.4<br>0                     | (204)<br>(206)<br>(208)  |
| Efficien<br>Efficien<br>Space   | ncy of n<br>ncy of s<br>Jan<br>heating<br>720.81  | nain spa<br>seconda<br>Feb<br>g require<br>547.95  | ace heat<br>ry/supple<br>Mar<br>ement (c<br>430.89   | ing syste<br>ementary<br>Apr<br>alculated<br>211.29  | em 1<br>y heating<br>May<br>d above)<br>71.52  | Jun   | n, %<br>Jul                             | Aug<br>0  | 02) × [1 –<br>Sep<br>0                                      | Oct<br>244.85<br>262.16   | 504.58<br>540.23   | 737.64<br>789.76                                   | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Efficien<br>Efficien<br>Space<br>(211)m =   | Decy of n       hecy of s       Jan       heating       720.81       = {[(98)       771.75  | reconda<br>Feb<br>g require<br>547.95<br>m x (20<br>586.67   | ace heat<br>ry/supple<br>Mar<br>ement (c<br>430.89<br>4)] } x 1<br>461.34  | Apr<br>alculated<br>211.29<br>00 ÷ (20<br>226.22   | em 1<br>y heating<br>May<br>d above)<br>71.52<br>06)<br>76.57  | Jun<br>)<br>0   | n, %<br>Jul<br>0                        | Aug<br>0  | 02) × [1 –<br>Sep<br>0                                      | Oct<br>244.85<br>262.16   | 504.58<br>540.23   | 737.64<br>789.76                                   | 1<br>93.4<br>0                     | (204)<br>(206)<br>(208)<br>ear                                     |
| Efficien<br>Efficien<br>Space<br>(211)m =   | heating<br>720.81<br>= {[(98)<br>771.75   | Feb<br>g require<br>547.95<br>mm x (20<br>586.67   | ace heat<br>ry/supple<br>ament (c<br>430.89<br>(4)] } x 1<br>(461.34<br>econdar  | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/   | em 1<br>y heating<br>May<br>d above)<br>71.52<br>06)<br>76.57  | Jun<br>)<br>0   | n, %<br>Jul<br>0                        | Aug<br>0  | 02) × [1 –<br>Sep<br>0                                      | Oct<br>244.85<br>262.16   | 504.58<br>540.23   | 737.64<br>789.76                                   | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Efficien<br>Efficien<br>Space<br>(211)m =<br>Space<br>= {[(98)n   | heating<br>720.81<br>= {[(98)<br>771.75<br>heating<br>m x (20   | nain spa<br>seconda<br><u>Feb</u><br><u>g require</u><br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1   | ace heat<br>ry/supple<br>mar<br>ement (c<br>430.89<br>4)] } x 1<br>461.34<br>econdar<br>00 ÷ (20   | ing syste<br>ementar<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)  | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month  | Jun           0           0                                   | n, %<br>Jul<br>0                        | Aug<br>0<br>Tota                                | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea                   | Oct<br>244.85<br>262.16<br>ar) =Sum(2   | 504.58<br>540.23<br>211) <sub>15,1012</sub>  | 737.64<br>789.76<br>=                              | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Efficien<br>Efficien<br>Space<br>(211)m =   | heating<br>720.81<br>= {[(98)<br>771.75   | Feb<br>g require<br>547.95<br>mm x (20<br>586.67   | ace heat<br>ry/supple<br>ament (c<br>430.89<br>(4)] } x 1<br>(461.34<br>econdar  | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/   | em 1<br>y heating<br>May<br>d above)<br>71.52<br>06)<br>76.57  | Jun<br>)<br>0   | n, %<br>Jul<br>0                        | Aug<br>0<br>Tota                                | 02) × [1 –<br>Sep<br>0<br>1 (kWh/yea                        | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0  | 504.58<br>540.23<br>211) <sub>15.1012</sub><br>0   | 737.64<br>789.76<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficien<br>Efficien<br>Space<br>(211)m =<br>(211)m =<br>Space<br>= {[(98)n<br>(215)m=  | hcy of n<br>hcy of s<br>Jan<br>heating<br>720.81<br>= {[(98)<br>771.75<br>heating<br>n x (20<br>0   | nain spa<br>seconda<br><u>Feb</u><br>g require<br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0   | ace heat<br>ry/supple<br>mar<br>ement (c<br>430.89<br>4)] } x 1<br>461.34<br>econdar<br>00 ÷ (20   | ing syste<br>ementar<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)  | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month  | Jun           0           0                                   | n, %<br>Jul<br>0                        | Aug<br>0<br>Tota                                | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea                   | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0  | 504.58<br>540.23<br>211) <sub>15.1012</sub><br>0   | 737.64<br>789.76<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Efficien<br>Efficien<br>Space<br>(211)m =<br>(211)m =<br>(211)m =<br>(215)m =<br>(215)m =   | heating<br>heating<br>720.81<br>$= \{[(98)]$<br>771.75<br>heating<br>$m \times (20)$<br>0<br>heating  | nain spa<br>econda<br><u>Feb</u><br>g require<br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0  | ace heat<br>ry/supple<br>ement (c<br>430.89<br>(4)] } x 1<br>461.34<br>econdar<br>00 ÷ (20<br>0  | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0  | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0                                       | Jun           0           0                                   | n, %<br>Jul<br>0                        | Aug<br>0<br>Tota                                | 02) × [1 –<br>Sep<br>0<br>1 (kWh/yea                        | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0  | 504.58<br>540.23<br>211) <sub>15.1012</sub><br>0   | 737.64<br>789.76<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficien<br>Efficien<br>Space<br>(211)m =<br>(211)m =<br>(215)m =<br>Water h<br>Output f  | heating<br>heating<br>720.81<br>$= \{[(98)]$<br>771.75<br>heating<br>m x (20)<br>0<br>heating<br>m x (20)   | nain spa<br>seconda<br><u>Feb</u><br><u>g require</u><br>547.95<br><u>m x (20</u><br>586.67<br><u>g fuel (s</u><br><u>1)] } x 1</u><br><u>0</u>                        | ace heat<br>ry/supple<br>ement (c<br>430.89<br>(4)] } x 1<br>(461.34<br>(20)<br>0) ÷ (20)<br>0<br>(0)  | ing syste<br>ementar<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0   | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0                                       | Jun           0           0           0           0           | n, % Jul 0                              | Aug<br>0<br>Tota<br>0<br>Tota                   | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea                   | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0<br>ar) =Sum(2                              | 504.58<br>540.23<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 737.64<br>789.76<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Efficien<br>Efficien<br>Space<br>(211)m =<br>(211)m =<br>(215)m =<br>Water h<br>Output f  | ncy of n         ncy of s         Jan         heating         720.81         = {[(98)         771.75         heating         n x (20         0         neating         irom wa         205.39   | nain spa<br>seconda<br>Feb<br>g require<br>547.95<br>mm x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0<br>ater hea<br>181.09   | ace heat<br>ry/supple<br>ement (c<br>430.89<br>(4)] } x 1<br>461.34<br>econdar<br>00 ÷ (20<br>0<br>(20<br>0<br>(20<br>0<br>(20<br>0)<br>(20<br>0)  | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0  | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0                                       | Jun           0           0                                   | n, %<br>Jul<br>0                        | Aug<br>0<br>Tota                                | 02) × [1 –<br>Sep<br>0<br>1 (kWh/yea                        | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0  | 504.58<br>540.23<br>211) <sub>15.1012</sub><br>0   | 737.64<br>789.76<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye<br>3714.7 | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)          |
| Efficien<br>Efficien<br>Space<br>(211)m =<br>(211)m =<br>(215)m=<br>Water h<br>Output f   | heating<br>(900) $(900)$ $(90$        | nain spa<br>econda<br>Feb<br>g require<br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0<br>ater hea<br>181.09<br>ater hea                                 | ace heat<br>ry/supple<br>ement (c<br>430.89<br>4)] } x 1<br>461.34<br>econdar<br>00 ÷ (20<br>0<br>ter (calc<br>188.58<br>ter   | ing syste<br>ementar<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0<br>ulated al<br>167.26                        | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0<br>0<br>0<br>00ve)<br>161.94          | Jun       0       0       0       142.63                      | n, %<br>Jul<br>0<br>0                   | Aug<br>0<br>Tota<br>0<br>Tota<br>152.33         | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea<br>154.01         | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>175.37                    | 504.58<br>540.23<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>187.04          | 737.64<br>789.76<br>=<br>0<br>=<br>200.51          | 1<br>93.4<br>0<br>kWh/ye           | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Efficient<br>Efficient<br>Space<br>(211)m =<br>(211)m =<br>(211)m =<br>(215)m =<br>(215)m =<br>Water h<br>Output f<br>Efficient<br>(217)m = | ncy of n         ncy of s         Jan         heating         720.81         = {[(98)         771.75         heating         m x (20         0         heating         0         0         0  | nain spa<br>seconda<br>Feb<br>g require<br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0<br>ater hea<br>181.09<br>ater hea<br>87.66                       | ace heat<br>ry/supple<br>ement (c<br>430.89<br>(4)] } x 1<br>461.34<br>(4)] } x 1<br>461.34<br>(20<br>0<br>0<br>(0)<br>(20<br>0<br>(0)<br>(20<br>0<br>(0)<br>(20)<br>(2  | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0<br>ulated al<br>167.26<br>85.64              | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0                                       | Jun           0           0           0           0           | n, % Jul 0                              | Aug<br>0<br>Tota<br>0<br>Tota                   | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea                   | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0<br>ar) =Sum(2                              | 504.58<br>540.23<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 737.64<br>789.76<br>=<br>0                         | 1<br>93.4<br>0<br>kWh/ye<br>3714.7 | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)          |
| Efficient<br>Efficient<br>Space<br>(211)m =<br>(211)m =<br>(215)m =<br>(215)m =<br>Water h<br>Output f<br>Efficient<br>(217)m =<br>Fuel for | heating<br>(900) $(900)(900)$ $(900)(900)(900)$ $(900)(900)(900)$ $(900)$  | nain spa<br>seconda<br>Feb<br>g require<br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0<br>ater hea<br>181.09<br>ater hea<br>87.66<br>neating,           | ace heat<br>ry/supple<br>ement (c<br>430.89<br>4)] } x 1<br>461.34<br>econdar<br>00 ÷ (20<br>0<br>188.58<br>ter<br>87.07<br>kWh/mo   | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0<br>ulated al<br>167.26<br>85.64<br>onth      | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0<br>0<br>0<br>00ve)<br>161.94          | Jun       0       0       0       142.63                      | n, %<br>Jul<br>0<br>0                   | Aug<br>0<br>Tota<br>0<br>Tota<br>152.33         | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea<br>154.01         | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>175.37                    | 504.58<br>540.23<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>187.04          | 737.64<br>789.76<br>=<br>0<br>=<br>200.51          | 1<br>93.4<br>0<br>kWh/ye<br>3714.7 | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Efficient<br>Efficient<br>Space<br>(211)m =<br>(211)m =<br>(215)m=<br>Water h<br>Output f<br>Efficient<br>(217)m=<br>Fuel for<br>(219)m =   | heating<br>720.81<br>$= \{[(98)]$<br>771.75<br>heating<br>n x (20)<br>0<br>heating<br>n x (20)<br>0<br>0<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.3 | nain spa<br>econda<br>Feb<br>g require<br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0<br>ater hea<br>181.09<br>ater hea<br>87.66<br>neating,<br>m x 100 | ace heat<br>ry/supple<br>mar<br>(ament (c<br>430.89<br>(4)] } x 1<br>461.34<br>(461.34<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34)<br>(461.34) | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0<br>ulated al<br>167.26<br>85.64<br>onth<br>m | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0<br>0<br>0<br>00ve)<br>161.94<br>83.15 | Jun         0         0         0         142.63         80.3 | n, %<br>Jul<br>0<br>0<br>136.65<br>80.3 | Aug<br>0<br>Tota<br>0<br>Tota<br>152.33<br>80.3 | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea<br>154.01<br>80.3 | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>175.37<br>85.89           | 504.58<br>540.23<br>211) <sub>15.1012</sub><br>0<br>215) <sub>15.1012</sub><br>187.04<br>87.43 | 737.64<br>789.76<br>=<br>0<br>=<br>200.51<br>88.03 | 1<br>93.4<br>0<br>kWh/ye<br>3714.7 | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Efficient<br>Efficient<br>Space<br>(211)m =<br>(211)m =<br>(215)m =<br>(215)m =<br>Water h<br>Output f<br>Efficient<br>(217)m =<br>Fuel for | heating<br>720.81<br>$= \{[(98)]$<br>771.75<br>heating<br>n x (20)<br>0<br>heating<br>n x (20)<br>0<br>0<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.39<br>205.3 | nain spa<br>seconda<br>Feb<br>g require<br>547.95<br>m x (20<br>586.67<br>g fuel (s<br>1)] } x 1<br>0<br>ater hea<br>181.09<br>ater hea<br>87.66<br>neating,           | ace heat<br>ry/supple<br>ement (c<br>430.89<br>4)] } x 1<br>461.34<br>econdar<br>00 ÷ (20<br>0<br>188.58<br>ter<br>87.07<br>kWh/mo   | ing syste<br>ementary<br>alculated<br>211.29<br>00 ÷ (20<br>226.22<br>y), kWh/<br>8)<br>0<br>ulated al<br>167.26<br>85.64<br>onth      | em 1<br>y heating<br>d above)<br>71.52<br>06)<br>76.57<br>month<br>0<br>0<br>0<br>00ve)<br>161.94          | Jun       0       0       0       142.63                      | n, %<br>Jul<br>0<br>0                   | Aug<br>0<br>Tota<br>0<br>Tota<br>152.33<br>80.3 | 02) × [1 –<br>Sep<br>0<br>0<br>I (kWh/yea<br>154.01         | Oct<br>244.85<br>262.16<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>175.37<br>85.89<br>204.18 | 504.58<br>540.23<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>187.04          | 737.64<br>789.76<br>=<br>0<br>=<br>200.51          | 1<br>93.4<br>0<br>kWh/ye<br>3714.7 | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |

| Annual totals<br>Space heating fuel used, main system 1         |                                 | kWh/year                      | Г   | <b>kWh/year</b><br>3714.7      | ]      |
|---|---------------------------------|-------------------------------|-----|--------------------------------|--------|
| Water heating fuel used   |                                 |                               | Γ   | 2421.96                        | ĺ      |
| Electricity for pumps, fans and electric keep-hot               |                                 |                               |     |                                | •      |
| central heating pump:   |                                 |                               | 30  |                                | (230c) |
| boiler with a fan-assisted flue                                 |                                 | Γ                             | 45  |                                | (230e) |
| Total electricity for the above, kWh/year                       | sum of (230a)                   | (230g) =                      |     | 75                             | (231)  |
| Electricity for lighting  |                                 |                               | Ē   | 360.52                         | (232)  |
| 12a. CO2 emissions – Individual heating systems                 | including micro-CHP             |                               |     |                                |        |
|   | <b>Energy</b><br>kWh/year       | Emission factor<br>kg CO2/kWh | or  | <b>Emissions</b><br>kg CO2/yea | r      |
| Space heating (main system 1)                                   | (211) x                         | 0.216                         | = [ | 802.38                         | (261)  |
| Space heating (secondary)                                       | (215) x                         | 0.519                         | = [ | 0                              | (263)  |
| Water heating   | (219) x                         | 0.216                         | = [ | 523.14                         | (264)  |
| Space and water heating   | (261) + (262) + (263) + (264) = |                               |     | 1325.52                        | (265)  |
| Elec <mark>tricity for pumps, fans and</mark> electric keep-hot | (231) x                         | 0.519                         | =   | 38.93                          | (267)  |
| Electricity for lighting  | (232) x                         | 0.519                         | - [ | 187.11                         | (268)  |
| Total CO2, kg/year  | sum o                           | of (265)(271) =               |     | 1551.55                        | (272)  |
|   |                                 |                               |     |                                | •      |

|  |  |                           | User D                       | etails:              |             |                  |                       |                           |                          |                        |
|--|--|---------------------------|------------------------------|----------------------|-------------|------------------|-----------------------|---------------------------|--------------------------|------------------------|
| Assessor Name:<br>Software Name:   | Stroma FSAP 20   |                           |                              | Stroma<br>Softwa     | re Ver      |                  |                       | Versio                    | n: 1.0.4.23              |                        |
| Address :  | 1 Bed Flat, 219-22   |                           |                              | Address:             |             | ah lunct         | tion I ON             |                           |                          |                        |
| 1. Overall dwelling dime   |  |                           | bour La                      | ne, Loug             | μηροιοαί    | gri Junci        | lion, LON             | NDOIN                     |                          |                        |
| Ground floor   |  |                           |                              | <b>a(m²)</b><br>19.8 | (1a) x      |                  | <b>ight(m)</b><br>2.5 | (2a) =                    | <b>Volume(m</b><br>124.5 | <sup>3</sup> )<br>(3a) |
| Total floor area TFA = (1a   | a)+(1b)+(1c)+(1d)+(1   | 1e)+(1n                   | ) 4                          | 19.8                 | (4)         |                  |                       |                           |                          |                        |
| Dwelling volume  |  |                           |                              |                      | (3a)+(3b)   | )+(3c)+(3c       | l)+(3e)+              | .(3n) =                   | 124.5                    | (5)                    |
| 2. Ventilation rate:   |  |                           |                              |                      |             |                  |                       |                           |                          |                        |
| Number of chimneys<br>Number of open flues   | main<br>heating<br>0 +   | secondary<br>heating<br>0 | <b>/</b><br>] + [_<br>] + [_ | 0<br>0               | ] = [       | <b>total</b> 0 0 |                       | 40 =<br>20 =              | m <sup>3</sup> per hou   | Jr<br>(6a)<br>(6b)     |
| Number of intermittent fa  |  | 0                         |                              | 0                    |             | -                |                       | 10 =                      | -                        |                        |
|  | 115  |                           |                              |                      | Ļ           | 2                |                       |                           | 20                       | (7a)                   |
| Number of passive vents  |  |                           |                              |                      | L           | 0                | X                     | 10 =                      | 0                        | (7b)                   |
| Number of flueless gas fi  | res  |                           |                              |                      |             | 0                | X 4                   | <sup>40</sup> =<br>Air ch | 0<br>anges per he        | (7c)<br>our            |
| Infiltration due to chimney  |  |                           |                              |                      |             | 20               |                       | ÷ (5) =                   | 0.16                     | (8)                    |
| If a pressurisation test has b<br>Number of storeys in th<br>Additional infiltration<br>Structural infiltration: 0.<br>if both types of wall are pr<br>deducting areas of openir | ne dwelling (ns)<br>25 for steel or timbe<br>resent, use the value corre | r frame or                | 0.35 for                     | masonr               | y constr    |                  |                       | -1]x0.1 =                 | 0<br>0<br>0              | (9)<br>(10)<br>(11)    |
| If suspended wooden f  | • • •  | aled) or 0.               | 1 (seale                     | d), else             | enter 0     |                  |                       |                           | 0                        | (12)                   |
| If no draught lobby, ent   |  |                           | ,                            | ,,                   |             |                  |                       |                           | 0                        | (13)                   |
| Percentage of windows  | s and doors draught  | stripped                  |                              |                      |             |                  |                       |                           | 0                        | (14)                   |
| Window infiltration  |  |                           |                              | 0.25 - [0.2          | x (14) ÷ 1  | = [00            |                       |                           | 0                        | (15)                   |
| Infiltration rate  |  |                           |                              | (8) + (10) -         | + (11) + (1 | 2) + (13) -      | + (15) =              |                           | 0                        | (16)                   |
| Air permeability value,  | q50, expressed in cu   | ubic metres               | s per ho                     | our per so           | quare m     | etre of e        | envelope              | area                      | 5                        | (17)                   |
| If based on air permeabil  | <b>3</b>   |                           |                              |                      |             |                  |                       |                           | 0.41                     | (18)                   |
| Air permeability value applie  |  | as been don               | e or a deg                   | ree air pei          | meability   | is being u       | sed                   |                           |                          |                        |
| Number of sides sheltere<br>Shelter factor   | a  |                           |                              | (20) = 1 - [         | 0.075 x (1  | 9)] =            |                       |                           | 3<br>0.78                | (19)<br>(20)           |
| Infiltration rate incorporat   | ing shelter factor   |                           |                              | (21) = (18)          |             |                  |                       |                           | 0.32                     | (20)                   |
| Infiltration rate modified for   | -  | ed                        |                              |                      |             |                  |                       |                           | 0.02                     |                        |
|  | Mar Apr May  | 1 1                       | Jul                          | Aug                  | Sep         | Oct              | Nov                   | Dec                       |                          |                        |
| Monthly average wind sp  | eed from Table 7   |                           |                              |                      |             |                  |                       |                           |                          |                        |
|  | 4.9 4.4 4.3  | 3.8                       | 3.8                          | 3.7                  | 4           | 4.3              | 4.5                   | 4.7                       |                          |                        |
| Wind Factor (22a)m = (22   | 2)m ÷ 4  | · ·                       |                              |                      |             |                  | -                     | •                         |                          |                        |
|  | 1.23 1.1 1.08  | 0.95                      | 0.95                         | 0.92                 | 1           | 1.08             | 1.12                  | 1.18                      |                          |                        |
| ·  | • •  |                           |                              |                      |             |                  | -                     |                           | •                        |                        |

| Adjust                           | ed infiltra                  | ation rat  | e (allowi  | ng for sh                               | elter an    | d wind s    | peed) =     | (21a) x       | (22a)m                                | -                  | -                | -                    |               |                         |
|----------------------------------|------------------------------|------------|------------|---|-------------|-------------|-------------|---------------|---------------------------------------|--------------------|------------------|----------------------|---------------|-------------------------|
| ~ / /                            | 0.41                         | 0.4        | 0.39       | 0.35                                    | 0.34        | 0.3         | 0.3         | 0.29          | 0.32                                  | 0.34               | 0.36             | 0.37                 |               |                         |
|                                  | <i>ate effec</i><br>echanica |            | -          | rate for t                              | he appli    | cable ca    | se          |               |                                       |                    |                  |                      |               | (23a)                   |
|                                  | aust air he                  |            |            | endix N, (2                             | 3b) = (23a  | a) × Fmv (e | equation (I | N5)) , othei  | wise (23b                             | ) = (23a)          |                  |                      | 0             | (23a)<br>(23b)          |
|                                  | anced with                   | • •        | 0 11       |   | , (         | , (         | • •         | ,, .          | ,                                     | , , ,              |                  |                      | 0             | (23c)                   |
| a) If                            | balance                      | d mecha    | anical ve  | entilation                              | with he     | at recove   | erv (MVI    | HR) (24a      | m = (22)                              | 2b)m + (           | 23b) × [′        | 1 – (23c)            | -             | ()                      |
| (24a)m=                          | r                            | 0          | 0          | 0                                       | 0           | 0           | 0           | 0             | 0                                     | 0                  | 0                | 0                    | ]             | (24a)                   |
| b) If                            | balance                      | d mecha    | anical ve  | entilation                              | without     | heat rec    | overy (N    | и<br>ЛV) (24b | )m = (22                              | 1<br>2b)m + (2     | 23b)             |                      | 1             |                         |
| ,<br>(24b)m=                     | 0                            | 0          | 0          | 0                                       | 0           | 0           | 0           | 0             | 0                                     | 0                  | 0                | 0                    |               | (24b)                   |
| c) If                            | whole ho                     | ouse ex    | tract ver  | ntilation of                            | or positiv  | ve input v  | ventilatio  | on from c     | outside                               | !                  | !                |                      | 1             |                         |
| ,                                | if (22b)m                    |            |            |   | •           | •           |             |               |                                       | 5 × (23b           | )                |                      |               |                         |
| (24c)m=                          | 0                            | 0          | 0          | 0                                       | 0           | 0           | 0           | 0             | 0                                     | 0                  | 0                | 0                    |               | (24c)                   |
| ,                                | natural v<br>if (22b)m       |            |            |   |             |             |             |               |                                       | 0.5]               |                  |                      | -             |                         |
| (24d)m=                          | 0.58                         | 0.58       | 0.58       | 0.56                                    | 0.56        | 0.55        | 0.55        | 0.54          | 0.55                                  | 0.56               | 0.56             | 0.57                 |               | (24d)                   |
| Effe                             | ctive air                    | change     | rate - er  | nter (24a                               | ) or (24t   | o) or (24   | c) or (24   | d) in boy     | (25)                                  |                    |                  |                      |               |                         |
| (25)m=                           | 0.58                         | 0.58       | 0.58       | 0.56                                    | 0.56        | 0.55        | 0.55        | 0.54          | 0.55                                  | 0 <mark>.56</mark> | 0.56             | 0.57                 |               | (25)                    |
| 3 He                             | at losses                    | and he     | at loss i  | naramete                                | ər:         |             |             |               |                                       |                    |                  |                      |               |                         |
| ELEN                             |                              | Gros       |            | Openin                                  |             | Net Ar      | ea          | U-valı        | le                                    | AXU                |                  | k-value              |               | AXk                     |
|                                  |                              | area       |            | m                                       |             | A ,r        |             | W/m2          |                                       | (W/I               | K)               | kJ/m <sup>2</sup> ·l |               | kJ/K                    |
| Windo                            | ws Type                      | 1          |            |   |             | 10.13       | x1          | /[1/( 1.4 )+  | 0.04] =                               | 13.43              |                  |                      |               | (27)                    |
| Windo                            | ws Type                      | 2          |            |   |             | 2.32        | x1          | /[1/( 1.4 )+  | 0.04] =                               | 3.08               |                  |                      |               | (27)                    |
| Wall <mark>s</mark> <sup>-</sup> | Type1                        | 19.        | 5          | 10.13                                   | 3           | 9.37        | x           | 0.18          | ] = [                                 | 1.69               |                  |                      |               | (29)                    |
| Walls <sup>-</sup>               | Type2                        | 3.5        |            | 2.32                                    |             | 1.18        | x           | 0.18          | = [                                   | 0.21               | ٦ ī              |                      | ┓ ┏           | (29)                    |
| Total a                          | rea of el                    | ements     | , m²       |   |             | 23          |             |               |                                       |                    |                  |                      |               | (31)                    |
| Party v                          | vall                         |            |            |   |             | 51.75       | 5 x         | 0             | =                                     | 0                  |                  |                      |               | (32)                    |
| Party f                          | loor                         |            |            |   |             | 49.8        |             |               | '                                     |                    | L                |                      | $\dashv$      | (32a)                   |
| Party of                         | ceiling                      |            |            |   |             | 49.8        |             |               |                                       |                    | Γ                |                      | $\exists$     | (32b)                   |
| Interna                          | al wall **                   |            |            |   |             | 45.6        |             |               |                                       |                    | Г                |                      | $\dashv$      | (32c)                   |
|                                  | dows and                     |            |            |   |             |             | ated using  | formula 1     | /[(1/U-valu                           | ie)+0.04] a        | L<br>as given in | paragraph            |               |                         |
|                                  | le the area<br>heat los      |            |            |   | s and par   | titions     |             | (26)(30)      | + (32) -                              |                    |                  |                      |               |                         |
|                                  | apacity (                    | -          |            | 0)                                      |             |             |             | (20)(00)      |                                       | (30) + (32         | 2) + (225)       | (220) -              | 18.4          | (33)                    |
|                                  | apacity (<br>al mass         |            |            | 2 – Cm ·                                | TEA) ir     | k l/m2k     |             |               |                                       | tive Value         | · · · ·          | (320) =              | 13281.        |                         |
|                                  | ign assessi                  | •          | •          |   |             |             |             | ecisely the   |                                       |                    |                  | able 1f              | 250           | (35)                    |
|                                  | used instea                  |            |            |   | conotract   |             | naionii pi  |               | maloutro                              | valuee of          |                  |                      |               |                         |
| Therm                            | al bridge                    | es : S (L  | x Y) cal   | culated u                               | using Ap    | pendix ł    | <           |               |                                       |                    |                  |                      | 2.25          | (36)                    |
|                                  | of therma                    |            | are not kn | own (36) =                              | = 0.05 x (3 | 1)          |             |               | ()                                    | ()                 |                  |                      | (             |                         |
|                                  | abric hea                    |            |            |   |             |             |             |               |                                       | (36) =             |                  |                      | 20.65         | (37)                    |
| Ventila                          | tion hea                     |            |            |   |             |             |             |               |                                       | = 0.33 × (         |                  | r                    | 1             |                         |
| (00)                             | Jan                          | Feb        | Mar        | Apr                                     | May         | Jun         | Jul         | Aug           | Sep                                   | Oct                | Nov              | Dec                  |               | (00)                    |
| (38)m=                           | 23.92                        | 23.79      | 23.66      | 23.06                                   | 22.95       | 22.42       | 22.42       | 22.32         | 22.62                                 | 22.95              | 23.18            | 23.42                | l             | (38)                    |
|                                  | ansfer c                     |            |            | , |             |             |             | 1             | · · · · · · · · · · · · · · · · · · · | = (37) + (3        |                  | 1                    | 1             |                         |
| (39)m=                           | 44.58                        | 44.44      | 44.32      | 43.71                                   | 43.6        | 43.07       | 43.07       | 42.97         | 43.27                                 | 43.6               | 43.83            | 44.07                | (             |                         |
| Stroma I                         | FSAP 2012                    | 2 Version: | 1.0.4.23   | (SAP 9.92)                              | - http://ww | ww.stroma   | .com        |               | ,                                     | Average =          | Sum(39)1         | 12 /12=              | 43.7 <b>þ</b> | age 2 o <sup>(39)</sup> |

| (40)m=       0.9       0.89       0.88       0.88       0.86       0.86       0.87       0.88       0.88       0.88         Average = Sum(40) 112 /12 = 0.88         Number of days in month (Table 1a)  | (40)         |
|--|--------------|
| Number of days in month (Table 1a)   | (40)         |
|  |              |
| Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec  |              |
| (41)m=         31         28         31         30         31         30         31         30         31         30         31  | (41)         |
|  |              |
| 4. Water heating energy requirement: kWh/year:   |              |
| Assumed occupancy, N<br>if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)<br>if TFA £ 13.9, N = 1   | (42)         |
| Annual average hot water usage in litres per day Vd,average = (25 x N) + 36<br>Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of<br>not more that 125 litres per person per day (all water use, hot and cold) | (43)         |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  |              |
| Hot water usage in litres per day for each month $Vd,m$ = factor from Table 1c x (43)  |              |
| (44)m=         81.62         78.65         75.68         72.72         69.75         66.78         69.75         72.72         75.68         78.65         81.62   |              |
| $Total = Sum(44)_{112} = 890.$ Energy content of hot water used - calculated monthly = 4.190 x Vd, m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)   | 4 (44)       |
|  |              |
| (45)m=         121.04         105.86         109.24         95.24         91.38         78.86         73.07         83.85         84.85         98.89         107.94         117.22  | (45)         |
| $Total = Sum(45)_{112} = 1167.$ If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)   | 46 (45)      |
| (46)m= 18.16 15.88 16.39 14.29 13.71 11.83 10.96 12.58 12.73 14.83 16.19 17.58   | (46)         |
| Water storage loss:  |              |
| Storage volume (litres) including any solar or WWHRS storage within same vessel  | (47)         |
| If community heating and no tank in dwelling, enter 110 litres in (47)   | -            |
| Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)   |              |
| Water storage loss:      a) If manufacturer's declared loss factor is known (kWh/day):   | (48)         |
| Temperature factor from Table 2b   | (49)         |
| Energy lost from water storage, kWh/year $(48) \times (49) = 0$  | (50)         |
| b) If manufacturer's declared cylinder loss factor is not known:   | (00)         |
| Hot water storage loss factor from Table 2 (kWh/litre/day)   | (51)         |
| If community heating see section 4.3 Volume factor from Table 2a   |              |
| Volume factor from Table 2a     0       Temperature factor from Table 2b     0   | (52)<br>(53) |
|  |              |
| Energy lost from water storage, kwn/year $(47) \times (51) \times (52) \times (53) = 0$<br>Enter (50) or (54) in (55) 0  | (54)<br>(55) |
| Water storage loss calculated for each month $((56)m = (55) \times (41)m$  | ()           |
| (56)m= 0 0 0 0 0 0 0 0 0 0 0 0 0   | (56)         |
| If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$ , else $(57)m = (56)m$ where (H11) is from Appendix H  | ()           |
| (57)m= 0 0 0 0 0 0 0 0 0 0 0 0   | (57)         |
| Primary circuit loss (annual) from Table 3   | (58)         |
| Primary circuit loss calculated for each month (59)m = (58) $\div$ 365 x (41)m   | x/           |
| (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)   |              |
| (59)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0   | (59)         |

| Combi                 | loss ca               | alculated                | for ea   | ch   | month (    | (61)m =   | (60   | D) ÷ 36             | 65 × (41)              | )m       |               |            |                    |              |            |                     |      |
|-----------------------|-----------------------|--------------------------|----------|------|------------|-----------|-------|---------------------|------------------------|----------|---------------|------------|--------------------|--------------|------------|---------------------|------|
| (61)m=                | 41.59                 | 36.2                     | 38.57    | 7    | 35.86      | 35.54     | 3     | 32.93               | 34.03                  | 35.54    | 4 35.86       | 6          | 38.57              | 38.79        | 41.59      | 7                   | (61) |
| Total h               | eat rec               | uired for                | water    | he   | ating ca   | alculated | d fo  | or eacl             | n month                | (62)m    | i = 0.85 :    | × (4       | 45)m +             | (46)m +      | (57)m ·    | <br>+ (59)m + (61)r | n    |
| (62)m=                | 162.63                | 142.06                   | 147.8    | 1    | 131.1      | 126.93    | 1     | 11.79               | 107.1                  | 119.4    | 4 120.7       | '1         | 137.46             | 146.73       | 158.81     |                     | (62) |
| Solar DH              | -IW input             | calculated               | using A  | ppe  | endix G or | Appendi   | хH    | (negativ            | ve quantity            | /) (ente | '0' if no so  | olar       | contribu           | tion to wate | er heating | g)                  |      |
| (add a                | dditiona              | al lines if              | FGHR     | Sa   | and/or V   | WHR       | S ap  | oplies              | see Ap                 | pendi    | (G)           |            |                    |              |            | _                   |      |
| (63)m=                | 0                     | 0                        | 0        |      | 0          | 0         |       | 0                   | 0                      | 0        | 0             |            | 0                  | 0            | 0          |                     | (63) |
| Output                | from v                | vater hea                | ter      |      |            |           |       |                     |                        |          |               |            |                    |              |            | _                   |      |
| (64)m=                | 162.63                | 142.06                   | 147.8    | 1    | 131.1      | 126.93    | 1     | 11.79               | 107.1                  | 119.4    | 120.7         | '1         | 137.46             | 146.73       | 158.81     |                     | _    |
|                       |                       |                          |          |      |            |           |       |                     |                        | C        | utput from    | wat        | ter heate          | er (annual)  | 112        | 1612.53             | (64) |
| Heat g                | ains fro              | om water                 | heatir   | ng,  | kWh/mo     | onth 0.2  | 5 ´   | [0.85               | × (45)m                | + (61    | )m] + 0.8     | 8 x        | [(46)m             | ı + (57)m    | + (59)r    | <u>m</u> ]          |      |
| (65)m=                | 50.64                 | 44.25                    | 45.96    | 3    | 40.63      | 39.27     | 3     | 34.45               | 32.8                   | 36.77    | 7 37.18       | 3          | 42.52              | 45.59        | 49.37      |                     | (65) |
| inclu                 | ide (57               | )m in calo               | culatio  | n o  | f (65)m    | only if a | cylii | nder is             | s in the o             | dwellir  | ng or hot     | wa         | ater is f          | rom com      | munity     | heating             |      |
| 5. Int                | ternal g              | ains (see                | e Table  | e 5  | and 5a)    | ):        |       |                     |                        |          |               |            |                    |              |            |                     |      |
| Metab                 | olic gai              | ns (Table                | e 5), W  | att  | S          |           |       |                     |                        |          |               |            |                    |              | -          |                     |      |
|                       | Jan                   | Feb                      | Ма       | r    | Apr        | May       |       | Jun                 | Jul                    | Au       | g Sep         | р          | Oct                | Nov          | Dec        | ;                   |      |
| (66)m=                | 84.21                 | 84.21                    | 84.21    |      | 84.21      | 84.21     | ٤     | 34.21               | 84.21                  | 84.2     | 84.21         | 1          | 84.21              | 84.21        | 84.21      |                     | (66) |
| Ligh <mark>tin</mark> | g gains               | s (calcula               | ted in   | Ap   | pendix l   | L, equa   | tion  | L9 oi               | <sup>r</sup> L9a), a   | lso se   | e Table       | 5          |                    |              |            |                     |      |
| (67)m=                | 1 <mark>3.08</mark>   | 11.62                    | 9.45     |      | 7.15       | 5.35      |       | <mark>4</mark> .51  | 4.88                   | 6.34     | 8.51          |            | 10.8               | 12.61        | 13.44      |                     | (67) |
| App <mark>lia</mark>  | nces ga               | ains (ca <mark>lc</mark> | ulated   | lin  | Append     | dix L, ec | Jua   | tion L <sup>2</sup> | 13 o <mark>r L1</mark> | 3a), a   | so see T      | Гab        | ole <mark>5</mark> |              |            |                     |      |
| (68)m=                | 1 <mark>4</mark> 6.71 | 148.2 <mark>4</mark>     | 144.4    | 1    | 136.23     | 125.92    | 1     | 16.23               | 109.76                 | 108.2    | 4 112.0       | 7          | 120.24             | 130.55       | 140.24     |                     | (68) |
| Cookir                | ng gains              | s (calcula               | ated in  | Ap   | pendix     | L, equa   | tior  | 1 L15               | or L15a)               | , also   | see Tab       | ole :      | 5                  |              | -          | _                   |      |
| (69)m=                | 31.42                 | 31.42                    | 31.42    | 2    | 31.42      | 31.42     | 3     | 31.42               | 31.42                  | 31.42    | 31.42         | 2          | 31.42              | 31.42        | 31.42      |                     | (69) |
| Pumps                 | and fa                | ans gains                | (Table   | ə 5  | a)         |           |       |                     |                        |          |               |            |                    |              |            |                     |      |
| (70)m=                | 3                     | 3                        | 3        |      | 3          | 3         |       | 3                   | 3                      | 3        | 3             |            | 3                  | 3            | 3          |                     | (70) |
| Losses                | s e.g. e              | vaporatic                | on (neg  | gati | ve valu    | es) (Tal  | ble   | 5)                  |                        |          | -             |            |                    |              | -          | _                   |      |
| (71)m=                | -67.37                | -67.37                   | -67.3    | 7    | -67.37     | -67.37    | -     | 67.37               | -67.37                 | -67.3    | 7 -67.3       | 7          | -67.37             | -67.37       | -67.37     |                     | (71) |
| Water                 | heating               | g gains (T               | able 5   | 5)   |            |           |       |                     |                        |          | -             |            |                    | -            | -          | _                   |      |
| (72)m=                | 68.07                 | 65.85                    | 61.78    | 3    | 56.43      | 52.78     | 4     | 17.85               | 44.09                  | 49.42    | 2 51.64       | 4          | 57.15              | 63.32        | 66.36      |                     | (72) |
| Total i               | nterna                | l gains =                | :        |      |            |           |       | (66)                | m + (67)m              | ı + (68) | m + (69)m     | + (7       | 70)m + (1          | 71)m + (72)  | -<br>)m    | _                   |      |
| (73)m=                | 279.13                | 276.97                   | 266.8    | 9    | 251.08     | 235.32    | 2     | 19.86               | 209.99                 | 215.2    | 6 223.4       | .8         | 239.46             | 257.74       | 271.31     | 7                   | (73) |
| 6. So                 | lar gain              | is:                      |          |      |            |           |       |                     |                        |          |               |            |                    |              |            |                     |      |
| Solar g               | ains are              | calculated               | using so | olar | flux from  | Table 6a  | and   | l associ            | ated equa              | tions to | convert to    | b the      | e applica          | ble orientat | tion.      |                     |      |
| Orienta               |                       | Access F                 |          |      | Area       |           |       | Flu                 |                        |          | g_<br>Table C | <b>`</b> L | -                  | FF           |            | Gains               |      |
|                       |                       | Table 6d                 |          |      | m²         |           |       | 1 at                | ole 6a                 |          | Table 6       | 30         | ا<br>— _           | Table 6c     |            | (W)                 | _    |
|                       | ast <mark>0.9x</mark> | 0.77                     |          | x    | 2.3        | 32        | x     | 3                   | 6.79                   | ×        | 0.63          |            | ×                  | 0.7          | =          | 26.09               | (77) |
| Southe                |                       | 0.77                     |          | x    | 2.3        | 32        | x     | 6                   | 2.67                   | ×        | 0.63          |            | _ × [              | 0.7          | =          | 44.44               | (77) |
| Southe                |                       | 0.77                     |          | x    | 2.3        | 32        | x     | 8                   | 5.75                   | x        | 0.63          |            | _ × [              | 0.7          | =          | 60.8                | (77) |
|                       | ast <mark>0.9x</mark> | 0.77                     |          | x    | 2.3        | 32        | x     | 10                  | 06.25                  | x        | 0.63          |            | _ × [              | 0.7          | =          | 75.33               | (77) |
| Southe                | ast <mark>0.9x</mark> | 0.77                     |          | x    | 2.3        | 32        | x     | 1                   | 19.01                  | x        | 0.63          |            | x                  | 0.7          | =          | 84.38               | (77) |

|  |  |   |   |   |  |  |   |   |   |  | _   |  |                                 |   |        |  |
|--|--|---|---|---|--|--|---|---|---|--|---|--|---------------------------------|---|--------|--|
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x   | 2.3   | 32   | x  | 1   | 18.15   | x   | 0.63   | x   | 0.7  |                                 | =                                       | 83.77  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x   | 2.3   | 32   | x  | 113.91  |   | x   | 0.63   | x   | 0.7  |                                 | =                                       | 80.76  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x   | 2.3   | 32   | x  | 10  | 04.39   | x   | 0.63   | x   | 0.7  |                                 | =                                       | 74.02  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x   | 2.3   | 32   | x  | 9   | 2.85  | x   | 0.63   | x   | 0.7  |                                 | =                                       | 65.83  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x   | 2.3   | 32   | x  | 6   | 9.27  | x   | 0.63   | ×   | 0.7  |                                 | =                                       | 49.11  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x   | 2.3   | 32   | x  | 4   | 4.07  | x   | 0.63   | x   | 0.7  |                                 | =                                       | 31.25  | (77)   |
| Southe   | ast <mark>0.9x</mark>  | 0.77  | x   | 2.3   | 32   | x  | 3   | 1.49  | x   | 0.63   | ×   | 0.7  |                                 | =                                       | 22.33  | (77)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | x   | 10.   | 13   | x  | 3   | 6.79  | İ   | 0.63   | x   | 0.7  |                                 | =                                       | 113.91 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | x   | 10.   | 13   | x  | 6   | 2.67  | 1   | 0.63   | x   | 0.7  |                                 | =                                       | 194.03 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | x   | 10.   | 13   | x  | 8   | 5.75  | İ   | 0.63   | x   | 0.7  |                                 | =                                       | 265.48 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | x   | 10.   | 13   | x  | 10  | 06.25   | 1   | 0.63   | ×   | 0.7  |                                 | =                                       | 328.94 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | x   | 10.   | 13   | x  |   | 19.01   | 1   | 0.63   | ×   | 0.7  |                                 | =                                       | 368.44 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | ×   | 10.   | 13   | x  | 1   | 18.15   | İ   | 0.63   | ×   | 0.7  |                                 | =                                       | 365.78 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | ×   | 10.   | 13   | x  | 1   | 13.91   |   | 0.63   | ×   | 0.7  |                                 | =                                       | 352.65 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | ×   | 10.   | 13   | x  | 1   | 04.39   | ]   | 0.63   | ×   | 0.7  |                                 | =                                       | 323.18 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | ×   | 10.   | 13   | x  | 9   | 2.85  |   | 0.63   | ×   | 0.7  |                                 | =                                       | 287.46 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | ×   | 10.   | 13   | x  | 6   | 9.27  |   | 0.63   | ×   | 0.7  |                                 | =                                       | 214.44 | (79)   |
| Sout <mark>hw</mark>   | est0.9x  | 0.77  | ×   | 10.   | 13   | x  | 4   | 4.07  |   | 0.63   | x   | 0.7  |                                 | =                                       | 136.44 | (79)   |
| Southw   | est <mark>0.9x</mark>  | 0.77  | ×   | 10.   | 13   | x  | 3   | 31.49   | i   | 0.63   | x   | 0.7  |                                 | -                                       | 97.48  | (79)   |
|  |  |   |   |   |  |  |   |   |   |  |   |  |                                 |   |        |  |
| Solar gains in watts, calculated for each month $(83)m = Sum(74)m \dots (82)m$   |  |   |   |   |  |  |   |   |   |  |   |  |                                 |   |        |  |
| Color  | noine in i   |   | aulata d  | for cool  | h month  | h  |   |   | (02)  | $C_{\rm H} = (7.4) m$  | (00)  |  |                                 |   |        |  |
| ~  |  | 1 1   | 1   |   |  | _  | 49 55   |   | r   |  | × ′   | 167.68   | 119                             | 81                                      |        | (83)   |
| (83)m=   | 140  | 238.47  | 326.28  | 404.27  | 452.82   | 4  | 49.55<br>83)m   | 433.41  | <mark>(83)m</mark><br>397   |  | (8 <mark>2)m</mark><br>263.5  | 5 167.68   | 119                             | .81                                     |        | (83)   |
| (83)m=<br>Total g  | 140<br>Jains — ir  | 238.47  | 326.28<br>d solar   | 404.27<br>(84)m =   | 452.82<br>= (73)m  | 44 + (8  | 83)m  | 433.41<br>, watts   | 397   | 19 353.29  | 263.5   |  | I                               |   |        |  |
| (83)m=<br>Total g<br>(84)m=  | 140<br> ains — ir<br> 419.12   | 238.47 ;<br>nternal an<br>515.43 ;  | 326.28<br>d solar<br>593.17   | 404.27<br>(84)m =<br>655.36   | 452.82<br>= (73)m<br>688.14  | 44 + (8  |   | 433.41  | r   | 19 353.29  | × ′   |  | 119<br>391                      |   |        | (83)<br>(84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me   | 140<br>Jains – ir<br>419.12<br>Jan inter   | 238.47 :<br>nternal an<br>515.43 :<br>nal tempe   | 32 <mark>6.28<br/>d solar</mark><br>593.17<br>rature (  | 404.27<br>(84)m =<br>655.36<br>(heating   | 452.82<br>= (73)m<br>688.14<br>seasor  | 44<br>+ (8<br>60   | 83)m<br>69.41   | 433.41<br>, watts<br>643.4  | 397<br>612  | 19         353.29           45         576.77  | 263.5   |  | I                               |   |        | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp   | 140<br>ains – ir<br>419.12<br>an inter<br>perature   | 238.47<br>nternal an<br>515.43<br>nal tempe<br>during he  | 326.28<br>d solar<br>593.17<br>rature<br>ating po   | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in  | 452.82<br>= (73)m<br>688.14<br>season<br>the liv   | 44<br>+ (8<br>60<br>n)   | 83)m<br>69.41<br>area 1   | 433.41<br>, watts<br>643.4<br>from Tab  | 397<br>612  | 19         353.29           45         576.77  | 263.5   |  | I                               |   | 21     |  |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp   | 140<br>Jains – II<br>419.12<br>Jan inter<br>perature<br>ation fac  | 238.47  | 326.28<br>d solar<br>593.17<br>rature<br>ating po<br>ns for li  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are   | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r   | 44<br>+ (8<br>60<br>n)<br>ring<br>m (so                        | 83)m<br>69.41<br>area f<br>ee Ta  | 433.41<br>, watts<br>643.4<br>from Tab<br>ble 9a)   | 397<br>612<br>ble 9,  | 19 353.29<br>45 576.77<br>Th1 (°C)   | 263.5   | 2 425.43   | 391                             | .12                                     | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa  | 140<br>Jains – ir<br>419.12<br>an inter<br>perature<br>ation fac<br>Jan  | 238.47<br>nternal an<br>515.43<br>nal tempe<br>during hea<br>tor for gain<br>Feb  | 326.28<br>d solar<br>593.17<br>rature (<br>ating po<br>ns for li<br>Mar   | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are<br>Apr  | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May  | 4.<br>+ ({<br>60<br>n)<br>ring<br>m (so                        | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun   | 433.41<br>, watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul  | 397<br>612<br>ble 9,  | 19 353.29<br>45 576.77<br>Th1 (°C)<br>Jg Sep   | 263.50<br>503.00  | 2 425.43<br>Nov  | 391                             | .12<br>ec                               | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp   | 140<br>Jains – II<br>419.12<br>Jan inter<br>perature<br>ation fac  | 238.47  | 326.28<br>d solar<br>593.17<br>rature<br>ating po<br>ns for li  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are   | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r   | 4.<br>+ ({<br>60<br>n)<br>ring<br>m (so                        | 83)m<br>69.41<br>area f<br>ee Ta  | 433.41<br>, watts<br>643.4<br>from Tab<br>ble 9a)   | 397<br>612<br>ble 9,  | 19 353.29<br>45 576.77<br>Th1 (°C)<br>Jg Sep   | 263.5   | 2 425.43   | 391                             | .12<br>ec                               | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean  | 140<br>Jains – Ii<br>419.12<br>Derature<br>ation fac<br>Jan<br>0.99<br>Interna   | 238.47<br>internal and<br>515.43<br>nal tempe<br>during head<br>tor for gain<br>Feb<br>0.96<br>I temperat   | 326.28<br>d solar<br>593.17<br>rature (<br>ating po<br>ns for li<br>Mar<br>0.89<br>ture in l  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>Apr<br>0.76<br>iving are   | 452.82<br>= (73)m<br>688.14<br>season<br>n the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f  | 44<br>+ (8<br>60<br>n)<br>ring<br>n (so                        | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41   | 433.41<br>, watts<br>643,4<br>from Tat<br>ble 9a)<br>Jul<br>0.29  | 397<br>612<br>ble 9,<br>Au<br>0.3   | 19     353.29       45     576.77       Th1 (°C)       Jg     Sep       2     0.51   | 263.53<br>503.02<br>Oct<br>0.81                                     | 2 425.43<br>Nov<br>0.97  | 391                             | .12<br>ec                               | 21     | (84)<br>(85)<br>(86)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=  | 140<br>Jains – ir<br>419.12<br>an inter<br>perature<br>ation fac<br>Jan<br>0.99  | 238.47<br>internal and<br>515.43<br>nal tempe<br>during head<br>tor for gain<br>Feb<br>0.96<br>I temperat   | 326.28<br>d solar<br>593.17<br>rature (<br>ating points for ling<br>Mar<br>0.89   | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are<br>Apr<br>0.76  | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58  | 44<br>+ (8<br>60<br>n)<br>ring<br>n (so                        | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41   | 433.41<br>, watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29  | 397<br>612<br>ble 9,<br>Au<br>0.3   | 19       353.29         45       576.77         Th1 (°C)   | 263.50<br>503.00  | 2 425.43<br>Nov<br>0.97  | 391                             | .12<br>ec                               | 21     | (84)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | 140<br>Jains – Ii<br>419.12<br>Jan inter<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35   | 238.47<br>anternal and<br>515.43<br>and tempe<br>during head<br>tor for gain<br>Feb<br>0.96<br>I temperat<br>20.56                                  | 326.28<br>d solar<br>593.17<br>rature (<br>ating point<br>ns for li<br>Mar<br>0.89<br>ture in l<br>20.78  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>Apr<br>0.76<br>iving are<br>20.93  | 452.82<br>= (73)m<br>688.14<br>season<br>n the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99   | 44<br>+ (((<br>60<br>n)<br>m (so<br>follo                      | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21  | 433.41<br>, watts<br>643.4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21   | 397<br>612<br>0le 9,<br>0.3<br>7 in T<br>2  | 19       353.29         45       576.77         Th1 (°C)   | 263.53<br>503.02<br>Oct<br>0.81                                     | 2 425.43<br>Nov<br>0.97  | 391                             | .12<br>ec                               | 21     | (84)<br>(85)<br>(86)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | 140<br>Jains – Ii<br>419.12<br>Jan inter<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35   | 238.47<br>anternal and<br>515.43<br>anal tempe<br>during hea<br>tor for gain<br>Feb<br>0.96<br>I temperat<br>20.56<br>during hea                    | 326.28<br>d solar<br>593.17<br>rature (<br>ating point<br>ns for li<br>Mar<br>0.89<br>ture in l<br>20.78  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>Apr<br>0.76<br>iving are<br>20.93  | 452.82<br>= (73)m<br>688.14<br>season<br>n the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99   | 44<br>+ (8<br>60<br>n)<br>ing<br>n (se<br>follo                | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21  | 433.41<br>, watts<br>643.4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21   | 397<br>612<br>0le 9,<br>0.3<br>7 in T<br>2  | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)   | 263.53<br>503.02<br>Oct<br>0.81                                     | 2 425.43<br>Nov<br>0.97<br>20.61   | 391                             | .12<br>ec<br>99                         | 21     | (84)<br>(85)<br>(86)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=  | 140<br>Jains – ir<br>419.12<br>an inter<br>perature<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35<br>perature<br>20.17                   | 238.47anternal and515.43and tempeduring heatduring heattor for gainFeb0.96I temperat20.56during heat20.17   | 326.28<br>d solar<br>593.17<br>rature (<br>ating p<br>ns for li<br>Mar<br>0.89<br>ture in l<br>20.78<br>ating p<br>20.18  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are<br>Apr<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19                                    | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19   | 44<br>+ (8<br>60<br>n)<br>ing<br>n (se<br>follo                | 83)m<br>69.41<br>area 1<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2                                     | 433.41<br>, watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2  | 397<br>612<br>612<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>8<br>8<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9 | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)   | 263.53<br>503.02<br>Oct<br>0.81<br>20.91                            | 2 425.43<br>Nov<br>0.97<br>20.61   | 391<br>D<br>0.9                 | .12<br>ec<br>99                         | 21     | (84)<br>(85)<br>(86)<br>(87)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=  | 140<br>Jains – ir<br>419.12<br>an inter<br>perature<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35<br>perature<br>20.17                   | 238.47<br>anternal and<br>515.43<br>anal tempe<br>during heat<br>tor for gain<br>Feb<br>0.96<br>I temperat<br>20.56<br>during heat<br>during heat   | 326.28<br>d solar<br>593.17<br>rature (<br>ating p<br>ns for li<br>Mar<br>0.89<br>ture in l<br>20.78<br>ating p<br>20.18  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods in<br>iving are<br>Apr<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19                                    | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19   | 44<br>+ (8<br>6<br>n)<br>ing<br>n (s<br>follo<br>follo<br>f dw | 83)m<br>69.41<br>area 1<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2                                     | 433.41<br>, watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2  | 397<br>612<br>612<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>8<br>8<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9 | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       20.19   | 263.53<br>503.02<br>Oct<br>0.81<br>20.91                            | 2 425.43<br>Nov<br>0.97<br>20.61   | 391<br>D<br>0.9                 | .12<br>ec<br>99<br>.3                   | 21     | (84)<br>(85)<br>(86)<br>(87)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=                   | 140<br>ains – ir<br>419.12<br>an inter<br>erature<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35<br>erature<br>20.17<br>ation fac<br>0.98 | 238.47anternal and515.43and tempeduring headduring headetor for gainFeb0.961 temperate20.56during head20.17etor for gain0.95                        | 326.28<br>d solar<br>593.17<br>rature (<br>ating points for line<br>Mar<br>0.89<br>ture in l<br>20.78<br>ating points<br>20.18<br>ns for r<br>0.87  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>0.76<br>iving are<br>20.93<br>eriods ir<br>20.19<br>est of do<br>0.72                      | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53                     | 44<br>+ (§<br>60<br>n)<br>n (se<br>follo                       | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>,m (se<br>0.36                   | 433.41<br>, watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24                      | 397           612           ble 9,           Ai           0.3           7 in T           2           able §           20.           9a)           0.2       | 19       353.29         45       576.77         Th1 (°C)         ug       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       0.19         7       0.46   | 263.53<br>503.02<br>503.02<br>0.81<br>20.91<br>20.19<br>20.19       | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18                                  | 391<br>D<br>0.9<br>20.          | .12<br>ec<br>99<br>.3                   | 21     | (84)<br>(85)<br>(86)<br>(87)<br>(88)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=<br>Mean           | 140jains – in419.12an interperatureation facJan0.99interna20.35perature20.17ation fac0.98interna   | 238.47anternal and515.43and tempeduring heatduring heattor for gainFeb0.96I temperate20.56during heat20.17ctor for gain0.95I temperate              | 326.28       d solar       593.17       rature (       ating pr       ns for li       Mar       0.89       ture in l       20.78       ating pr       20.18       ns for r       0.87       ture in t                           | 404.27 (84)m =<br>655.36<br>(heating<br>eriods in<br>iving are<br>Apr<br>0.76<br>iving are<br>20.93<br>eriods in<br>20.19<br>est of dv<br>0.72<br>the rest      | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53<br>of dwel          | 44<br>+ ({<br>66<br>n)<br>ing<br>n (se<br>follo                | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>,m (se<br>0.36<br>T2 (fe         | 433.41<br>, watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24<br>ollow ste         | 397<br>612<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>0.3<br>90<br>0.2<br>90<br>90<br>0.2  | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       0.19         7       0.46         to 7 in Table   | 263.53<br>503.02<br>0.81<br>20.91<br>20.19<br>0.77<br>e 9c)         | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96                          | 391<br>D<br>0.9<br>20.<br>0.9   | .12<br>ec<br>99<br>.3<br>18             | 21     | (84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(88)<br>(89)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=                   | 140<br>ains – ir<br>419.12<br>an inter<br>erature<br>ation fac<br>Jan<br>0.99<br>interna<br>20.35<br>erature<br>20.17<br>ation fac<br>0.98 | 238.47anternal and515.43and tempeduring heatduring heattor for gainFeb0.96I temperate20.56during heat20.17ctor for gain0.95I temperate              | 326.28<br>d solar<br>593.17<br>rature (<br>ating points for line<br>Mar<br>0.89<br>ture in l<br>20.78<br>ating points<br>20.18<br>ns for r<br>0.87  | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>0.76<br>iving are<br>20.93<br>eriods ir<br>20.19<br>est of do<br>0.72                      | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53                     | 44<br>+ ({<br>66<br>n)<br>ing<br>n (se<br>follo                | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>,m (se<br>0.36                   | 433.41<br>, watts<br>643,4<br>from Tab<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24                      | 397<br>612<br>ble 9,<br>0.3<br>7 in T<br>2<br>20.<br>9a)<br>0.2   | 19       353.29         45       576.77         Th1 (°C)   | 263.53<br>503.02<br>0.02<br>20.91<br>20.19<br>0.77<br>e 9c)<br>20.1 | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96<br>19.7                  | 391<br>0.9<br>20.<br>20.<br>19. | .12<br>ec<br>99<br>.3<br>18             |        | <ul> <li>(84)</li> <li>(85)</li> <li>(86)</li> <li>(87)</li> <li>(88)</li> <li>(89)</li> <li>(90)</li> </ul> |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=<br>Mean<br>(90)m= | 140Jains – in419.12an interan interation facJan0.99interna20.35perature20.17ation fac0.98interna19.32                                      | 238.47anternal and515.43and temperduring headetor for gainFeb0.96I temperate20.56during head20.17etor for gain0.95I temperate19.62                  | 326.28       d solar       593.17       rature       ating persistent       ns for li       Mar       0.89       ture in l       20.78       ating persistent       20.18       ns for r       0.87       ture in t       19.92 | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>0.76<br>iving are<br>20.93<br>eriods ir<br>20.19<br>est of dv<br>0.72<br>the rest<br>20.12 | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53<br>of dwel<br>20.18 | 44<br>+ ({<br>60<br>n)<br>ing<br>n (s<br>follo                 | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>,m (se<br>0.36<br>T2 (fe<br>20.2 | 433.41<br>, watts<br>643,4<br>from Tak<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24<br>ollow ste<br>20.2 | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>able §<br>20<br>9a)<br>0.2<br>eps 3<br>20.  | 19       353.29         45       576.77         Th1 (°C)         Jg       Sep         2       0.51         able 9c)       21         0, Th2 (°C)       2         2       0.46         to 7 in Tabl       2         2       20.19         7       0.46         to 7 in Tabl       2         2       20.19           | 263.53<br>503.02<br>0.02<br>20.91<br>20.19<br>0.77<br>e 9c)<br>20.1 | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96                          | 391<br>0.9<br>20.<br>20.<br>19. | .12<br>ec<br>99<br>.3<br>18             | 0.47   | (84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(88)<br>(89)   |
| (83)m=<br>Total g<br>(84)m=<br>7. Me<br>Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=<br>Temp<br>(88)m=<br>Utilisa<br>(89)m=<br>Mean<br>(90)m= | 140Jains – in419.12an interan interation facJan0.99interna20.35perature20.17ation fac0.98interna19.32                                      | 238.47anternal and515.43and temperduring heatduring heattor for gainFeb0.96I temperat20.56during heat20.17tor for gain0.95I temperat19.62I temperat | 326.28       d solar       593.17       rature       ating persistent       ns for li       Mar       0.89       ture in l       20.78       ating persistent       20.18       ns for r       0.87       ture in t       19.92 | 404.27<br>(84)m =<br>655.36<br>(heating<br>eriods ir<br>iving are<br>0.76<br>iving are<br>20.93<br>eriods ir<br>20.19<br>est of dv<br>0.72<br>the rest<br>20.12 | 452.82<br>= (73)m<br>688.14<br>season<br>the liv<br>ea, h1,r<br>May<br>0.58<br>ea T1 (f<br>20.99<br>n rest of<br>20.19<br>welling,<br>0.53<br>of dwel<br>20.18 | 44<br>+ (8<br>6<br>n)<br>ing<br>n (su<br>follo                 | 83)m<br>69.41<br>area f<br>ee Ta<br>Jun<br>0.41<br>w ste<br>21<br>velling<br>20.2<br>,m (se<br>0.36<br>T2 (fe<br>20.2 | 433.41<br>, watts<br>643,4<br>from Tak<br>ble 9a)<br>Jul<br>0.29<br>ps 3 to 7<br>21<br>from Ta<br>20.2<br>ee Table<br>0.24<br>ollow ste<br>20.2 | 397<br>612<br>612<br>612<br>0.3<br>7 in T<br>2<br>able §<br>20<br>9a)<br>0.2<br>eps 3<br>20.  | 19       353.29         19       353.29         45       576.77         Th1 (°C)       Jg         Jg       Sep         2       0.51         able 9c)       21         9, Th2 (°C)       2         2       0.19         7       0.46         to 7 in Tabl       2         2       20.19         f       - fLA) × T2 | 263.53<br>503.02<br>0.02<br>20.91<br>20.19<br>0.77<br>e 9c)<br>20.1 | 2 425.43<br>Nov<br>0.97<br>20.61<br>20.18<br>0.96<br>19.7<br>ring area ÷ ( | 391<br>0.9<br>20.<br>20.<br>19. | .12<br>ec<br>99<br>.3<br>18<br>99<br>26 |        | <ul> <li>(84)</li> <li>(85)</li> <li>(86)</li> <li>(87)</li> <li>(88)</li> <li>(89)</li> <li>(90)</li> </ul> |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m=         19.8         20.06         20.32         20.5         20.56         20.57         20.57         20.57         20.48         20.12         19.75           2         Space booting requirement  | (93)                      |  |  |  |  |  |  |  |  |  |
|---|---------------------------|--|--|--|--|--|--|--|--|--|
| 8. Space heating requirement  |                           |  |  |  |  |  |  |  |  |  |
| Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a  |                           |  |  |  |  |  |  |  |  |  |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec   | :                         |  |  |  |  |  |  |  |  |  |
| Utilisation factor for gains, hm:   |                           |  |  |  |  |  |  |  |  |  |
| (94)m= 0.98 0.95 0.87 0.73 0.55 0.38 0.27 0.29 0.48 0.79 0.95 0.99  | (94)                      |  |  |  |  |  |  |  |  |  |
| Useful gains, hmGm , $W = (94)m \times (84)m$   | -                         |  |  |  |  |  |  |  |  |  |
| (95)m= 411.37 488.43 518.72 479.89 381.6 256.86 171.09 179.31 278.38 396.32 405.91 385.93   | (95)                      |  |  |  |  |  |  |  |  |  |
| Monthly average external temperature from Table 8   | _                         |  |  |  |  |  |  |  |  |  |
| (96)m=         4.3         4.9         6.5         8.9         11.7         14.6         16.6         16.4         14.1         10.6         7.1         4.2  | (96)                      |  |  |  |  |  |  |  |  |  |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ]  | _                         |  |  |  |  |  |  |  |  |  |
| (97)m= 690.84 673.92 612.37 507.02 386.15 257.22 171.12 179.36 279.87 430.8 570.78 685.06   | (97)                      |  |  |  |  |  |  |  |  |  |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m   | -                         |  |  |  |  |  |  |  |  |  |
| (98)m= 207.93 124.65 69.67 19.53 3.38 0 0 0 0 25.66 118.7 222.56  | ;<br>                     |  |  |  |  |  |  |  |  |  |
| Total per year (kWh/year) = Sum(98) <sub>15,912</sub>   | = 792.09 (98)             |  |  |  |  |  |  |  |  |  |
| Space heating requirement in kWh/m²/year  | 15.91 (99)                |  |  |  |  |  |  |  |  |  |
| 9a. Energy requirements – Individual heating systems including micro-CHP)   |                           |  |  |  |  |  |  |  |  |  |
| Space heating:  |                           |  |  |  |  |  |  |  |  |  |
| Fraction of space heat from secondary/supplementary system  | 0 (201)                   |  |  |  |  |  |  |  |  |  |
| Fraction of space heat from main system(s) (202) = 1 - (201) =  | 1 (202)                   |  |  |  |  |  |  |  |  |  |
| Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$   | 1 (204)                   |  |  |  |  |  |  |  |  |  |
|   |                           |  |  |  |  |  |  |  |  |  |
| Efficiency of main space heating system 1   | 93.4 (206)                |  |  |  |  |  |  |  |  |  |
| Efficiency of secondary/supplementary heating system, %   | 0 (208)                   |  |  |  |  |  |  |  |  |  |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec   | kWh/year                  |  |  |  |  |  |  |  |  |  |
| Space heating requirement (calculated above)  | -                         |  |  |  |  |  |  |  |  |  |
| 207.93 124.65 69.67 19.53 3.38 0 0 0 0 25.66 118.7 222.56   | 5                         |  |  |  |  |  |  |  |  |  |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206)   | (211)                     |  |  |  |  |  |  |  |  |  |
| 222.62         133.46         74.6         20.91         3.62         0         0         0         27.47         127.09         238.29   | )                         |  |  |  |  |  |  |  |  |  |
| Total (kWh/year) =Sum(211) <sub>15,1012</sub> =   | 848.06 (211)              |  |  |  |  |  |  |  |  |  |
| Space heating fuel (secondary), kWh/month   |                           |  |  |  |  |  |  |  |  |  |
| = {[(98)m x (201)] } x 100 ÷ (208)  | -                         |  |  |  |  |  |  |  |  |  |
| (215)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0   |                           |  |  |  |  |  |  |  |  |  |
| Total (kWh/year) =Sum(215) <sub>15,1012</sub> =   | 0 (215)                   |  |  |  |  |  |  |  |  |  |
| Water heating   |                           |  |  |  |  |  |  |  |  |  |
| Output from water heater (calculated above)   | -                         |  |  |  |  |  |  |  |  |  |
| 162.63         142.06         147.81         131.1         126.93         111.79         107.1         119.4         120.71         137.46         146.73         158.81  |                           |  |  |  |  |  |  |  |  |  |
| Efficiency of water heater  | 80.3 (216)                |  |  |  |  |  |  |  |  |  |
| (217)m= 85.67 84.72 83.28 81.48 80.53 80.3 80.3 80.3 80.3 81.74 84.52 85.9  | (217)                     |  |  |  |  |  |  |  |  |  |
| Fuel for water heating, kWh/month   |                           |  |  |  |  |  |  |  |  |  |
| $(219)m = (64)m \times 100 \div (217)m$<br>$(219)m = 189.83 \ 167.68 \ 177.48 \ 160.9 \ 157.61 \ 139.22 \ 133.38 \ 148.69 \ 150.33 \ 168.17 \ 173.6 \ 184.88$   |                           |  |  |  |  |  |  |  |  |  |
| $(219)\text{ff} = \frac{189.83}{107.68} \frac{107.68}{177.48} \frac{177.61}{100.9} \frac{157.61}{139.22} \frac{133.38}{139.22} \frac{148.69}{150.33} \frac{150.33}{108.17} \frac{168.17}{173.6} \frac{184.88}{184.88}$ $\text{Total} = \text{Sum}(219a)_{1.12} =$ |                           |  |  |  |  |  |  |  |  |  |
|   | 1951.76 (219)             |  |  |  |  |  |  |  |  |  |
| Annual totals kWh/year<br>Space heating fuel used, main system 1  | <b>kWh/year</b><br>848.06 |  |  |  |  |  |  |  |  |  |
|   | 0-0.00                    |  |  |  |  |  |  |  |  |  |

|   |                           |                                   |     |                                | 1      |
|---|---------------------------|-----------------------------------|-----|--------------------------------|--------|
| Water heating fuel used                           |                           |                                   |     | 1951.76                        |        |
| Electricity for pumps, fans and electric keep-hot |                           |                                   |     |                                |        |
| central heating pump:                             |                           |                                   | 30  | ]                              | (230c) |
| boiler with a fan-assisted flue                   |                           |                                   | 45  |                                | (230e) |
| Total electricity for the above, kWh/year         |                           |                                   | 75  | (231)                          |        |
| Electricity for lighting                          |                           |                                   |     | 230.99                         | (232)  |
| 12a. CO2 emissions – Individual heating systems   | including micro-C         | CHP                               |     |                                | -      |
|   | <b>Energy</b><br>kWh/year | <b>Emission fac</b><br>kg CO2/kWh | tor | <b>Emissions</b><br>kg CO2/yea | r      |
| Space heating (main system 1)                     | (211) x                   | 0.216                             | =   | 183.18                         | (261)  |
| Space heating (secondary)                         | (215) x                   | 0.519                             | =   | 0                              | (263)  |
| Water heating                                     | (219) x                   | 0.216                             | =   | 421.58                         | (264)  |
| Space and water heating                           | (261) + (262) + (263      | 3) + (264) =                      |     | 604.76                         | (265)  |
| Electricity for pumps, fans and electric keep-hot | (231) x                   | 0.519                             | =   | 38.93                          | (267)  |
| Electricity for lighting                          | (232) x                   | 0.519                             | =   | 119.88                         | (268)  |
| Total CO2, kg/year TER =                          |                           | sum of (265)(271) =               |     | 763.57<br>15.33                | (272)  |

| User Details:  |  |                               |   |                      |                |   |                       |                      |                                   |                     |  |  |
|--|--|-------------------------------|---|----------------------|----------------|---|-----------------------|----------------------|-----------------------------------|---------------------|--|--|
| Assessor Name:<br>Software Name:   | ftware Name: Stroma FSAP 2012  |                               |   |                      |                | Stroma Number:<br>Software Version: Versio<br>perty Address: Flat 1 |                       |                      |                                   |                     |  |  |
| Addross I  | 1 Bed Flat, 219-223  |                               |   |                      |                | nh lunct  | tion I ON             |                      |                                   |                     |  |  |
| Address :<br>1. Overall dwelling dimer   |  | Columan                       |   | ne, Loug             | μηροιοαί       | JII JUIICI  |                       |                      |                                   |                     |  |  |
| Ground floor   |  |                               | Area<br>5                               |                      | (1a) x         | <b>Av. He</b>   | <b>ight(m)</b><br>2.5 | (2a) =               | Volume(m <sup>3</sup> )<br>129.25 | (3a)                |  |  |
| Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$<br>51.7 (4)   |  |                               |   |                      |                |   |                       |                      |                                   |                     |  |  |
| Dwelling volume  |  |                               |   |                      | (3a)+(3b)      | +(3c)+(3d   | l)+(3e)+              | .(3n) =              | 129.25                            | (5)                 |  |  |
| 2. Ventilation rate:   |  |                               |   |                      |                |   |                       |                      |                                   |                     |  |  |
| Number of chimneys<br>Number of open flues   |  | econdary<br>neating<br>0<br>0 | / · · · · · · · · · · · · · · · · · · · | 0<br>0<br>0          | ] = [<br>] = [ | <b>total</b> 0 0  |                       | 40 =<br>20 =         | m <sup>3</sup> per hour           | (6a)<br>(6b)        |  |  |
| Number of intermittent fan   | s  |                               | J L                                     |                      | ' F            | 0   | x                     | 0 =                  | 0                                 | <br>_(7a)           |  |  |
| Number of passive vents  |  |                               |   |                      |                | 0   | x ^                   | 0 =                  | 0                                 | ](7b)               |  |  |
| Number of flueless gas fire  | es   |                               |   |                      |                | 0   | x 4                   | 40 =                 | 0                                 | (7c)                |  |  |
| Air ch   |  |                               |   |                      |                |   |                       |                      |                                   | changes per hour    |  |  |
| Infiltration due to chimneys<br>If a pressurisation test has be<br>Number of storeys in the<br>Additional infiltration<br>Structural infiltration: 0.2<br>if both types of wall are pre-<br>deducting areas of opening           | en carried out or is intende<br>e dwelling (ns)<br>25 for steel or timber<br>esent, use the value corres | ed, proceed<br>frame or       | to (17), o<br>0.35 for                  | therwise c<br>masonr | y constr       |   | (16)                  | ÷ (5) =<br>•1]x0.1 = | 0<br>0<br>0<br>0                  | (9)<br>(10)<br>(11) |  |  |
| deducting areas of openings); if equal user 0.35<br>If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0  |  |                               |   |                      |                |   |                       |                      |                                   | (12)                |  |  |
| If no draught lobby, ente  | er 0.05, else enter 0  |                               |   |                      |                |   |                       |                      | 0                                 | (13)                |  |  |
| Percentage of windows and doors draught stripped   |  |                               |   |                      |                |   |                       |                      |                                   | (14)                |  |  |
| Window infiltration  |  |                               |   | 0.25 - [0.2          |                | 0   | (15)                  |                      |                                   |                     |  |  |
| Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) =$   |  |                               |   |                      |                |   |                       |                      | 0                                 | (16)                |  |  |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area  |  |                               |   |                      |                |   |                       |                      | 2                                 | (17)                |  |  |
| If based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$<br><i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i> (18) |  |                               |   |                      |                |   |                       |                      |                                   | (18)                |  |  |
| Number of sides sheltered  |  | s been done                   | e or a deg                              | iee all per          | Πεαρπιτγ       | s being us  | 360                   |                      | 2                                 | (19)                |  |  |
| Shelter factor $(20) = 1 - [0.075 \times (19)] =$  |  |                               |   |                      |                |   |                       |                      | 0.85                              | (20)                |  |  |
| Infiltration rate incorporating shelter factor (21) = (18) x (20) =  |  |                               |   |                      |                |   |                       |                      | 0.08                              | (21)                |  |  |
| Infiltration rate modified fo  | r monthly wind speed   | b                             |   |                      |                |   |                       | •                    |                                   | _                   |  |  |
| Jan Feb M  | Mar Apr May  | Jun                           | Jul                                     | Aug                  | Sep            | Oct   | Nov                   | Dec                  |                                   |                     |  |  |
| Monthly average wind spe   | ed from Table 7  |                               |   |                      |                |   |                       |                      |                                   |                     |  |  |
| (22)m= 5.1 5 4   | 4.9 4.4 4.3  | 3.8                           | 3.8                                     | 3.7                  | 4              | 4.3   | 4.5                   | 4.7                  |                                   |                     |  |  |
| Wind Factor (22a)m = (22   | )m ÷ 4   |                               |   |                      |                |   |                       |                      |                                   |                     |  |  |
| (22a)m= 1.27 1.25 1  | .23 1.1 1.08   | 0.95                          | 0.95                                    | 0.92                 | 1              | 1.08  | 1.12                  | 1.18                 |                                   |                     |  |  |

| Adjust    | ed infiltr              | ation rat  | e (allowi                 | ng for sl                             | nelter an                  | d wind s    | peed) =     | (21a) x                               | (22a)m          |             |             |           | _              |                |
|-----------|-------------------------|------------|---------------------------|---------------------------------------|----------------------------|-------------|-------------|---------------------------------------|-----------------|-------------|-------------|-----------|----------------|----------------|
|           | 0.11                    | 0.11       | 0.1                       | 0.09                                  | 0.09                       | 0.08        | 0.08        | 0.08                                  | 0.08            | 0.09        | 0.1         | 0.1       |                |                |
|           | late effe<br>echanica   |            | -                         | rate for t                            | the appli                  | cable ca    | se          |                                       |                 |             |             |           | 0.5            | (23a)          |
|           |                         |            |                           | endix N. (2                           | 23b) = (23a                | ) x Fmv (e  | equation (N | N5)), othe                            | rwise (23b      | ) = (23a)   |             |           | 0.5            | (23a)          |
|           |                         |            |                           |                                       | allowing f                 |             |             |                                       |                 | , (,        |             |           | 0.5            | (230)<br>(23c) |
|           |                         |            | -                         | -                                     | with hea                   |             |             |                                       |                 | 2h)m + (    | 23h) v ['   | 1 – (23c) | 73.1<br>÷ 1001 | (230)          |
| (24a)m=   | 0.24                    | 0.24       | 0.24                      | 0.23                                  | 0.23                       | 0.22        | 0.22        | 0.21                                  | 0.22            | 0.23        | 0.23        | 0.23      | ]              | (24a)          |
|           |                         |            |                           |                                       | without                    |             |             |                                       |                 |             |             |           | 1              |                |
| (24b)m=   |                         |            |                           | 0                                     |                            |             |             |                                       | 0               |             | 0           | 0         | 1              | (24b)          |
|           |                         |            | tract ver                 | tilation (                            | or positiv                 |             | /entilatio  | n from c                              | utside          |             |             |           | l              |                |
|           |                         |            |                           |                                       | c) = (23b                  | -           |             |                                       |                 | .5 × (23b   | <b>)</b> )  |           |                |                |
| (24c)m=   | 0                       | 0          | 0                         | 0                                     | 0                          | 0           | 0           | 0                                     | 0               | 0           | 0           | 0         |                | (24c)          |
| d) If     | natural                 | ventilatio | on or wh                  | ole hous                              | se positiv                 | e input     | ventilatio  | on from l                             | oft             |             |             |           | 1              |                |
|           | if (22b)n               | n = 1, th  | en (24d)                  | m = (22                               | b)m othe                   | rwise (2    | 4d)m = (    | 0.5 + [(2                             | 2b)m² x         | 0.5]        |             |           | 1              |                |
| (24d)m=   | 0                       | 0          | 0                         | 0                                     | 0                          | 0           | 0           | 0                                     | 0               | 0           | 0           | 0         |                | (24d)          |
|           | r                       | <u> </u>   |                           | · · · · · · · · · · · · · · · · · · · | ) or (24b                  | , ,         | , ,         | · · · · · · · · · · · · · · · · · · · | <u> </u>        |             | 1           | 1         | 1              |                |
| (25)m=    | 0.24                    | 0.24       | 0.24                      | 0.23                                  | 0.23                       | 0.22        | 0.22        | 0.21                                  | 0.22            | 0.23        | 0.23        | 0.23      |                | (25)           |
| 3. He     | at l <mark>osse</mark>  | s and he   | eat loss                  | oaramet                               | er:                        |             |             |                                       |                 |             |             |           |                |                |
|           | <b>NENT</b>             | Gros       |                           | Openir                                | -                          | Net Ar      |             | U-valu                                |                 | AXU         |             | k-value   |                | AXk            |
| \A/' - 1- | . <b>.</b> .            | area       | (m²)                      | n                                     | 1 <sup>2</sup>             | A ,r        |             | W/m2                                  |                 | (W/I        | K)          | kJ/m²·l   | K              | kJ/K           |
|           | ws Type                 |            |                           |                                       |                            | 10.35       |             | [1/( 0.73 )-                          | Ļ               | 7.34        |             |           |                | (27)           |
|           | ws Type                 | e 2        |                           |                                       |                            | 4.51        |             | [1/( 0.73 )+                          | + 0.04] =       | 3.2         | 닐 .         |           |                | (27)           |
| Floor     |                         |            |                           |                                       |                            | 51.7        | ×           | 0.06                                  | =               | 3.102       |             |           |                | (28)           |
| Walls     | Type1                   | 19.7       | 75                        | 10.3                                  | 5                          | 9.4         | X           | 0.15                                  | = [             | 1.41        |             |           |                | (29)           |
| Walls     | Type2                   | 14.7       | 75                        | 4.51                                  |                            | 10.24       | x           | 0.15                                  | =               | 1.54        |             |           |                | (29)           |
| Walls     | Туре3                   | 20         | )                         | 0                                     |                            | 20          | x           | 0.15                                  | =               | 3           |             |           |                | (29)           |
| Total a   | area of e               | elements   | , m²                      |                                       |                            | 106.2       | 2           |                                       |                 |             |             |           |                | (31)           |
| Party     | wall                    |            |                           |                                       |                            | 20          | x           | 0                                     | =               | 0           |             |           |                | (32)           |
| Party     | ceiling                 |            |                           |                                       |                            | 51.7        |             |                                       |                 |             |             |           |                | (32b)          |
| Interna   | al wall **              |            |                           |                                       |                            | 77          |             |                                       |                 |             |             |           |                | (32c)          |
|           |                         |            |                           |                                       | indow U-va<br>Ils and part |             | ated using  | formula 1                             | /[(1/U-valu     | ie)+0.04] a | as given in | paragraph | n 3.2          |                |
| Fabric    | heat los                | ss, W/K :  | = S (A x                  | U)                                    |                            |             |             | (26)(30)                              | + (32) =        |             |             |           | 19.59          | (33)           |
| Heat c    | apacity                 | Cm = S(    | (A x k )                  |                                       |                            |             |             |                                       | ((28)           | (30) + (32  | 2) + (32a). | (32e) =   | 11299.9        | 9 (34)         |
| Therm     | al mass                 | parame     | eter (TMF                 | P = Cm -                              | ÷ TFA) in                  | ı kJ/m²K    |             |                                       | Indica          | tive Value  | : Medium    |           | 250            | (35)           |
|           | -                       |            | ere the de<br>tailed calc |                                       | e constructi               | ion are not | t known pr  | ecisely the                           | e indicative    | e values of | TMP in Ta   | able 1f   |                |                |
| Therm     | al bridg                | es : S (L  | x Y) cal                  | culated                               | using Ap                   | pendix ł    | <           |                                       |                 |             |             |           | 7.96           | (36)           |
|           | s of therma<br>abric he |            | are not kn                | own (36) :                            | = 0.05 x (3                | 1)          |             |                                       | ( <b>33</b> ) ± | (36) =      |             |           | 07 55          | (27)           |
|           |                         |            | alculated                 | month                                 | v                          |             |             |                                       |                 |             | 25)m x (5)  |           | 27.55          | (37)           |
| v Gritik  | Jan                     | Feb        | Mar                       | Apr                                   | y<br>May                   | Jun         | Jul         | Aug                                   | Sep             | Oct         | Nov         | Dec       | ]              |                |
|           | Jun                     |            |                           |                                       | Interv                     | Jun         |             | , lug                                 |                 |             |             |           | I              |                |

| (38)m=     | 10.36                     | 10.27               | 10.18                   | 9.72       | 9.63        | 9.18        | 9.18                | 9.09             | 9.36         | 9.63                   | 9.82        | 10                  |         | (38)         |
|------------|---------------------------|---------------------|-------------------------|------------|-------------|-------------|---------------------|------------------|--------------|------------------------|-------------|---------------------|---------|--------------|
| Heat tr    | ansfer o                  | coefficie           | nt, W/K                 |            |             |             |                     |                  | (39)m        | = (37) + (3            | 38)m        |                     |         |              |
| (39)m=     | 37.91                     | 37.82               | 37.73                   | 37.27      | 37.18       | 36.73       | 36.73               | 36.64            | 36.91        | 37.18                  | 37.36       | 37.54               |         |              |
| Heat lo    | iss nara                  | meter (I            | HLP), W                 | /m²K       |             |             |                     |                  |              | Average =<br>= (39)m ÷ |             | 12 /12=             | 37.25   | (39)         |
| (40)m=     | 0.73                      | 0.73                | 0.73                    | 0.72       | 0.72        | 0.71        | 0.71                | 0.71             | 0.71         | 0.72                   | 0.72        | 0.73                |         |              |
|            |                           | 1                   | ļ                       |            |             |             |                     |                  | ,<br>,       | Average =              | Sum(40)1.   | 12 /12=             | 0.72    | (40)         |
| Numbe      |                           | r                   | nth (Tab                | ,<br>1     |             |             |                     |                  |              |                        |             |                     |         |              |
| (11)       | Jan                       | Feb                 | Mar                     | Apr        | May         | Jun         | Jul                 | Aug              | Sep          | Oct                    | Nov         | Dec                 |         | (41)         |
| (41)m=     | 31                        | 28                  | 31                      | 30         | 31          | 30          | 31                  | 31               | 30           | 31                     | 30          | 31                  |         | (41)         |
| 4 \//0     | tor boot                  | ting one            |                         | iromonti   |             |             |                     |                  |              |                        |             | k) Mb /vo           | 05      |              |
| 4. vva     | ter nea                   | ung ene             | rgy requ                | irement.   |             |             |                     |                  |              |                        |             | kWh/ye              | ar.     |              |
|            |                           | ipancy,             | N<br>+ 1.76 x           | [1 ovp     | ( 0 0003    |             | - 12 0              | ) <u>) ) ) )</u> | 1012 v (*    | TEA 12                 |             | 74                  |         | (42)         |
|            | A £ 13.9                  |                     | + 1.70 X                | li - exh   | (-0.0003    | 949 X (11   | -A - 13.9           | )2)] + 0.0       | JU13 X (     | IFA - 13.              | 9)          |                     |         |              |
|            |                           |                     | ater usag               |            |             |             |                     |                  |              | a targat a             |             | .53                 |         | (43)         |
|            |                           | -                   | hot water<br>person pe  |            |             | -           | -                   | o achieve        | a water us   | se largel o            | 1           |                     |         |              |
|            | Jan                       | Feb                 | Mar                     | Apr        | May         | Jun         | Jul                 | Aug              | Sep          | Oct                    | Nov         | Dec                 |         |              |
| Hot wate   | e <mark>r u</mark> sage i | n litres pe         | r day for ea            |            |             |             | Table 1c x          | <u> </u>         |              |                        |             |                     |         |              |
| (44)m=     | <mark>8</mark> 3.08       | 80.06               | 77.04                   | 74.02      | 71          | 67.98       | 67. <mark>98</mark> | 71               | 74.02        | 77.04                  | 80.06       | <mark>8</mark> 3.08 |         |              |
| Eporou     | contant of                | bot water           | used - cal              | aulated m  | opthly - A  | 100 v Vd r  |                     | Tm / 2600        |              | Total = Su             |             |                     | 906.36  | (44)         |
|            | 123.21                    | 107.76              | 111.2                   | 96.95      | 93.02       | 80.27       | 74.38               | 85.36            | 86.37        | 100.66                 | 109.88      | 119.32              |         |              |
| (45)m=     | 123.21                    | 107.76              | 111.2                   | 90.95      | 93.02       | 00.27       | 74.30               | 00.00            |              | Total = Su             |             | L                   | 1188.38 | (45)         |
| lf instant | aneous w                  | vater heati         | ing at point            | of use (no | o hot water | r storage), | enter 0 in          | boxes (46        |              |                        |             | L                   |         | `            |
| (46)m=     | 18.48                     | 16.16               | 16.68                   | 14.54      | 13.95       | 12.04       | 11.16               | 12.8             | 12.96        | 15.1                   | 16.48       | 17.9                |         | (46)         |
|            | storage                   |                     | ) includir              |            | alar or M   |             | storado             | within er        |              | sol                    | <b></b>     |                     |         | (47)         |
|            |                           |                     | ) includir<br>and no ta |            |             |             |                     |                  |              | 501                    |             | 0                   |         | (47)         |
|            | •                         | -                   | hot wate                |            | -           |             |                     | . ,              | ers) ente    | er '0' in (            | 47)         |                     |         |              |
|            | storage                   |                     |                         |            |             |             |                     |                  |              |                        |             |                     |         |              |
|            |                           |                     | eclared I               |            | or is kno   | wn (kWł     | n/day):             |                  |              |                        |             | 0                   |         | (48)         |
|            |                           |                     | om Table                |            |             |             |                     | (40) (40)        |              |                        |             | 0                   |         | (49)         |
|            |                           |                     | r storage<br>eclared o  | •          |             | or is not   |                     | (48) x (49)      | ) =          |                        |             | 0                   |         | (50)         |
| Hot wa     | ter stor                  | age loss            | factor fr               | om Tabl    |             |             |                     |                  |              |                        |             | 0                   |         | (51)         |
|            | •                         | eating s<br>from Ta | see secti               | on 4.3     |             |             |                     |                  |              |                        |             | ]                   |         | (50)         |
|            |                           |                     | om Table                | 2b         |             |             |                     |                  |              |                        |             | 0<br>0              |         | (52)<br>(53) |
| -          |                           |                     | r storage               |            | ear         |             |                     | (47) x (51)      | ) x (52) x ( | 53) =                  |             | 0                   |         | (54)         |
|            |                           | (54) in (ধ          | -                       |            |             |             |                     |                  |              |                        |             | 0                   |         | (55)         |
| Water      | storage                   | loss cal            | culated                 | for each   | month       |             |                     | ((56)m = (       | 55) × (41)   | m                      |             |                     |         |              |
| (56)m=     | 0                         | 0                   | 0                       | 0          | 0           | 0           | 0                   | 0                | 0            | 0                      | 0           | 0                   |         | (56)         |
| If cylinde | r contains                | s dedicate          | d solar sto             | rage, (57) | m = (56)m   | x [(50) – ( | H11)] ÷ (5          | 0), else (5      | 7)m = (56)   | m where (              | H11) is fro | m Appendi           | хH      |              |
| (57)m=     | 0                         | 0                   | 0                       | 0          | 0           | 0           | 0                   | 0                | 0            | 0                      | 0           | 0                   |         | (57)         |

| Primary circu<br>Primary circu | •   | ,             |                 |            | 59)m = (  | (58) ÷ 36       | 65 × (41)            | m            |                           |             | 0           |                    | (58) |  |  |
|--------------------------------|---|---------------|-----------------|------------|-----------|-----------------|----------------------|--------------|---------------------------|-------------|-------------|--------------------|------|--|--|
| (modified b                    | y factor f  | rom Tab       | le H5 if t      | here is s  | solar wat | ter heati       | ng and a             | a cylinde    | r thermo                  | stat)       |             |                    |      |  |  |
| (59)m= 0                       | 0   | 0             | 0               | 0          | 0         | 0               | 0                    | 0            | 0                         | 0           | 0           |                    | (59) |  |  |
| Combi loss ca                  | alculated   | for each      | month           | (61)m =    | (60) ÷ 30 | 65 × (41        | )m                   |              |                           |             |             |                    |      |  |  |
| (61)m= 11.77                   | 10.62   | 11.74         | 11.35           | 11.72      | 11.32     | 11.69           | 11.71                | 11.34        | 11.73                     | 11.37       | 11.76       |                    | (61) |  |  |
| Total heat red                 | uired for   | water h       | eating ca       | alculated  | for eac   | h month         | (62)m =              | 0.85 ×       | (45)m +                   | (46)m +     | (57)m +     | ,<br>(59)m + (61)r | n    |  |  |
| (62)m= 134.98                  | 118.38  | 122.94        | 108.29          | 104.74     | 91.59     | 86.07           | 97.06                | 97.71        | 112.39                    | 121.25      | 131.09      |                    | (62) |  |  |
| Solar DHW input                | calculated  | using App     | endix G o       | r Appendix | H (negati | ve quantity     | y) (enter '0         | ' if no sola | r contribut               | ion to wate | er heating) | I                  |      |  |  |
| (add addition                  | al lines if   | FGHRS         | and/or \        | NWHRS      | applies   | , see Ap        | pendix (             | G)           |                           |             |             |                    |      |  |  |
| (63)m= 0                       | 0   | 0             | 0               | 0          | 0         | 0               | 0                    | 0            | 0                         | 0           | 0           |                    | (63) |  |  |
| Output from w                  | vater hea   | iter          | -               |            |           |                 | -                    | -            |                           | -           | -           | '                  |      |  |  |
| (64)m= 134.98                  | 118.38  | 122.94        | 108.29          | 104.74     | 91.59     | 86.07           | 97.06                | 97.71        | 112.39                    | 121.25      | 131.09      |                    |      |  |  |
|                                | Output from water heater (annual)       1326.51       (64)         Heat gains from water heating, kWh/month 0.25 $(0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$ |               |                 |            |           |                 |                      |              |                           |             |             |                    |      |  |  |
| Heat gains fro                 | om water  | heating       | , kWh/m         | onth 0.2   | 5 ´ [0.85 | × (45)m         | n + (61)m            | n] + 0.8 x   | k [(46)m                  | + (57)m     | + (59)m     | ]                  |      |  |  |
| (65)m= 43.91                   | 38.49   | 39.91         | 35.07           | 33.86      | 29.52     | 27.66           | 31.31                | 31.55        | 36.4                      | 39.38       | 42.62       |                    | (65) |  |  |
| include (57                    | )m in cal   | culation      | of (65)m        | only if c  | ylinder i | s in the o      | dwelling             | or hot w     | ate <mark>r is f</mark> r | om com      | munity h    | eating             |      |  |  |
| 5. Internal g                  | ains (see   | e Table {     | 5 and <b>5a</b> | ):         |           |                 |                      |              |                           |             |             |                    |      |  |  |
| Met <mark>abolic</mark> gai    | ns (Table   | e 5), Wat     | tts             |            |           |                 |                      |              |                           |             |             |                    |      |  |  |
| Jan                            | Feb   | Mar           | Apr             | May        | Jun       | Jul             | Aug                  | Sep          | Oct                       | Nov         | Dec         |                    |      |  |  |
| (66)m= 87.01                   | 87.01   | <b>87</b> .01 | 87.01           | 87.01      | 87.01     | 87.01           | 87.01                | 87.01        | 8 <mark>7.01</mark>       | 87.01       | 87.01       |                    | (66) |  |  |
| Lighting gains                 | s (calcula  | ted in A      | opendix         | L, equat   | ion L9 o  | r L9a), a       | lso see <sup>:</sup> | Table 5      |                           |             |             |                    |      |  |  |
| (67)m= 18.24                   | 16.2  | 13.18         | 9.98            | 7.46       | 6.3       | 6.8             | 8.84                 | 11.87        | 15.07                     | 17.59       | 18.75       |                    | (67) |  |  |
| Appliances ga                  | ains (calc  | ulated ir     | n Append        | dix L, eq  | uation L  | 13 or L1        | 3a), also            | see Ta       | ble 5                     |             |             |                    |      |  |  |
| (68)m= 151.65                  | 153.22  | 149.26        | 140.81          | 130.16     | 120.14    | 113.45          | 111.88               | 115.84       | 124.28                    | 134.94      | 144.96      |                    | (68) |  |  |
| Cooking gain                   | s (calcula  | ated in A     | ppendix         | L, equa    | tion L15  | or L15a         | ), also se           | ee Table     | 5                         |             |             | I                  |      |  |  |
| (69)m= 31.7                    | 31.7  | 31.7          | 31.7            | 31.7       | 31.7      | 31.7            | 31.7                 | 31.7         | 31.7                      | 31.7        | 31.7        |                    | (69) |  |  |
| Pumps and fa                   | ans gains   | (Table :      | 5a)             |            |           |                 |                      |              |                           |             |             | I                  |      |  |  |
| (70)m= 3                       | 3   | 3             | 3               | 3          | 3         | 3               | 3                    | 3            | 3                         | 3           | 3           |                    | (70) |  |  |
| Losses e.g. e                  | vaporatio   | n (nega       | tive valu       | es) (Tab   | le 5)     |                 |                      |              |                           |             |             | I                  |      |  |  |
| (71)m= -69.61                  | -69.61  | -69.61        | -69.61          | -69.61     | -69.61    | -69.61          | -69.61               | -69.61       | -69.61                    | -69.61      | -69.61      |                    | (71) |  |  |
| Water heating                  | gains (1  | rable 5)      | 1               |            |           |                 |                      |              |                           |             |             | I                  |      |  |  |
| (72)m= 59.02                   | 57.27   | 53.64         | 48.71           | 45.51      | 41        | 37.17           | 42.08                | 43.82        | 48.93                     | 54.69       | 57.28       |                    | (72) |  |  |
| Total interna                  | l gains =   |               |                 |            | (66)      | ı<br>)m + (67)n | י<br>1 + (68)m -     | + (69)m +    | (70)m + (7                | 1)m + (72)  | m           | ]                  |      |  |  |
| (73)m= 281.01                  | 278.8   | 268.18        | 251.6           | 235.23     | 219.54    | 209.53          | 214.9                | 223.64       | 240.39                    | 259.32      | 273.09      |                    | (73) |  |  |
| 6. Solar gair                  | IS:   |               |                 |            |           |                 |                      |              |                           |             |             |                    |      |  |  |
| Solar gains are                | calculated  | using sola    | r flux from     | Table 6a   | and assoc | iated equa      | ations to co         | onvert to th | ne applicat               | le orientat | ion.        |                    |      |  |  |
| Orientation:                   | Access F  | actor         | Area            |            | Flu       | IX              |                      | g_           |                           | FF          |             | Gains              |      |  |  |

| Orientation:   | Access Facto<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|----------------|--------------------------|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9> | 0.77                     | x | 4.51       | x | 11.28            | × | 0.63           | x | 0.1            | = | 2.22         | (75) |
| Northeast 0.9> | 0.77                     | x | 4.51       | x | 22.97            | × | 0.63           | × | 0.1            | = | 4.52         | (75) |

|                             |                         | _        |             |           |                 |                     | -          |              |                     |                        |        |            |      |
|-----------------------------|-------------------------|----------|-------------|-----------|-----------------|---------------------|------------|--------------|---------------------|------------------------|--------|------------|------|
| Northeast 0.9               | 0.11                    | x        | 4.51        |           | x               | 41.38               | x          | 0.63         | x                   | 0.1                    | =      | 8.15       | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | X (             | 67.96               | x          | 0.63         | x                   | 0.1                    | =      | 13.38      | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | x g             | 91.35               | x          | 0.63         | x                   | 0.1                    | =      | 17.99      | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | x g             | 97.38               | x          | 0.63         | x                   | 0.1                    | =      | 19.18      | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | x               | 91.1                | x          | 0.63         | x                   | 0.1                    | =      | 17.94      | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | x               | 72.63               | x          | 0.63         | x                   | 0.1                    | =      | 14.3       | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | x !             | 50.42               | x          | 0.63         | x                   | 0.1                    | =      | 9.93       | (75) |
| Northeast 0.9               | 0.77                    | ×        | 4.51        |           | ×               | 28.07               | x          | 0.63         | x                   | 0.1                    | =      | 5.53       | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | x               | 14.2                | x          | 0.63         | x                   | 0.1                    | =      | 2.8        | (75) |
| Northeast 0.9               | 0.77                    | x        | 4.51        |           | x               | 9.21                | x          | 0.63         | x                   | 0.1                    | =      | 1.81       | (75) |
| Southwest0.9                | 0.77                    | x        | 10.35       | ;         | x;              | 36.79               | ]          | 0.63         | x                   | 0.1                    | =      | 16.63      | (79) |
| Southwest0.9                | 0.77                    | x        | 10.35       | ;         | x (             | 62.67               | ]          | 0.63         | x                   | 0.1                    | =      | 28.32      | (79) |
| Southwest0.9                | 0.77                    | x        | 10.35       | ;         | x t             | 35.75               | ]          | 0.63         | x                   | 0.1                    | =      | 38.75      | (79) |
| Southwest0.9                | 0.77                    | ×        | 10.35       | ;         | × 1             | 06.25               | ]          | 0.63         | x                   | 0.1                    | =      | 48.01      | (79) |
| Southwest0.9                | 0.77                    | x        | 10.35       | ;         | × 1             | 19.01               | ]          | 0.63         | x                   | 0.1                    | =      | 53.78      | (79) |
| Southwest0.9                | 0.77                    | x        | 10.35       | ;         | × 1             | 18.15               | ]          | 0.63         | x                   | 0.1                    | =      | 53.39      | (79) |
| Southwest0.9                | 0.77                    | x        | 10.35       | ;         | × 1             | 13.91               | ]          | 0.63         | x                   | 0.1                    | =      | 51.47      | (79) |
| Southwest0.9                | 0.77                    | x        | 10.35       | ;         | × 1             | 04.39               |            | 0.63         | x                   | 0.1                    | =      | 47.17      | (79) |
| Southwest0.9                | 0.77                    | ×        | 10.35       | ;         | x               | 92.85               |            | 0.63         | x                   | 0.1                    | -      | 41.96      | (79) |
| Sout <mark>hwest</mark> 0.9 | 0.77                    | ×        | 10.35       | ;         | ×               | 69.27               |            | 0.63         | x                   | 0.1                    | =      | 31.3       | (79) |
| Sout <mark>hwest</mark> 0.9 | 0.77                    | x        | 10.35       | ;         | ×               | 44.07               |            | 0.63         | x                   | 0.1                    | =      | 19.91      | (79) |
| Sout <mark>hwest</mark> 0.9 | 0.77                    | ×        | 10.35       |           | x :             | 31.4 <mark>9</mark> | 1          | 0.63         | x                   | 0.1                    | _ =    | 14.23      | (79) |
|                             |                         |          |             |           |                 |                     |            |              |                     |                        |        |            |      |
| Sola <mark>r gains i</mark> | n watts, calcu          | ulated   | for each    | month     |                 |                     | (83)m      | = Sum(74)m . | <mark>(8</mark> 2)m |                        |        |            |      |
| ( <mark>83)m=</mark> 18.85  | 32.84                   | 46.9     | 61.39       | 71.76     | 72.56           | 69.41               | 61.        | 47 51.88     | 36.83               | 22.71                  | 16.04  |            | (83) |
| Total gains -               | internal and            | solar    | (84)m = (   | (73)m +   | + (83)m         | , watts             |            |              |                     |                        |        |            |      |
| (84)m= 299.8                | 6 311.64 3 <sup>-</sup> | 15.08    | 313         | 306.99    | 292.11          | 278.94              | 276        | .37 275.52   | 277.21              | 282.03                 | 289.13 |            | (84) |
| 7. Mean int                 | ernal tempera           | ature    | (heating s  | eason)    | )               |                     |            |              |                     |                        |        |            |      |
| Temperatu                   | e during hea            | iting p  | eriods in t | the livir | ng area         | from Tab            | ole 9      | Th1 (°C)     |                     |                        |        | 21         | (85) |
| Utilisation fa              | actor for gain          | s for l  | iving area  | i, h1,m   | (see Ta         | able 9a)            |            |              |                     |                        |        |            |      |
| Jan                         | Feb                     | Mar      | Apr         | May       | Jun             | Jul                 | A          | ug Sep       | Oct                 | Nov                    | Dec    |            |      |
| (86)m= 1                    | 1 (                     | 0.99     | 0.98        | 0.93      | 0.77            | 0.58                | 0.         | 6 0.84       | 0.97                | 1                      | 1      |            | (86) |
| Mean interr                 | al temperatu            | ure in l | iving area  | a T1 (fo  | ollow ste       | eps 3 to 7          | 7 in T     | able 9c)     |                     |                        |        |            |      |
| (87)m= 20.34                | <u> </u>                | 20.54    | <u> </u>    | 20.88     | 20.98           | 21                  | 2          |              | 20.77               | 20.53                  | 20.33  |            | (87) |
| Temperatu                   | e during hea            | tina n   | eriods in i | rest of a | dwelling        | i from Ta           | hle 9      |              |                     |                        |        |            |      |
| (88)m= 20.31                |                         | 20.31    | 1           | 20.32     | 20.33           | 20.33               | 20.        |              | 20.32               | 20.32                  | 20.32  |            | (88) |
|                             | -11                     |          |             | I         |                 | Į                   | I          | I            | L                   |                        | L      | I          |      |
| (89)m = 1                   | actor for gain          | 0.99     | 0.97        | 0.9       | 12,m (se<br>0.7 | 0.49                | 9a)<br>0.5 | 0.79         | 0.96                | 0.99                   | 1      |            | (89) |
|                             |                         |          |             |           | -               | Į                   |            |              |                     | 0.35                   |        |            | (00) |
|                             | al temperatu            | i        | 1           | 1         | - ·             | 1                   | r –        | 1            | ,                   | 4.5-                   | 46.5   | l          | (00) |
| (90)m= 19.42                | 19.53 1                 | 9.71     | 19.97       | 20.2      | 20.32           | 20.33               | 20.        |              | 20.05               | 19.7<br>ring area ÷ (4 | 19.4   | <b>a</b> – | (90) |
|                             |                         |          |             |           |                 |                     |            | T            | LA = LIV            | mu area ÷ (4           | +/ =   | 0.5        | (91) |

| Maaa  |   |   | atura lta  | ماريد مرماند م   | مام مابيم  | 11:m m) f  | I A TA                                 | . / 4 4   | A) TO  |  |  |  |                          |  |
|---|---|---|--|--|--|--|--|---|--|--|--|--|--------------------------|--|
| (92)m=  | 19.89   | 19.97   | ature (fo  | 20.34  | 20.54  | 1110() = 1100()                                    | 20.67                                  | + (1 – 1L<br>20.67                              | 20.63  | 20.41  | 20.12  | 19.87  |                          | (92)   |
|   |   |   | he mean  |  |  |  |  |   |  |  | 20.12  | 10.07  |                          | (02)   |
| (93)m=  | 19.74   | 19.82   | 19.98  | 20.19  | 20.39  | 20.5   | 20.52                                  | 20.52   | 20.48  | 20.26  | 19.97  | 19.72  |                          | (93)   |
|   |   |   | uirement   |  |  |  |  |   |  |  |  |  |                          |  |
|   |   |   | ternal ter   |  | re obtair  | ned at st  | ep 11 of                               | Table 9   | b. so tha  | t Ti.m=(   | 76)m an  | d re-calc  | ulate                    |  |
|   |   |   | or gains   | •  |  |  |  |   |  |  |  |  |                          |  |
|   | Jan   | Feb   | Mar  | Apr  | May  | Jun  | Jul                                    | Aug   | Sep  | Oct  | Nov  | Dec  |                          |  |
| Utilisat  | tion fac  | tor for g   | ains, hm   | :  |  |  |  |   |  |  |  |  |                          |  |
| (94)m=  | 1   | 0.99  | 0.99   | 0.97   | 0.9  | 0.72   | 0.51                                   | 0.54  | 0.8  | 0.96   | 0.99   | 1  |                          | (94)   |
| -   | gains,  |   | , W = (94  | , <u> </u>   | · · · · · · · · · · · · · · · · · · ·  |  | 1                                      |   | 1  |  |  | 1  | 1                        |  |
| ι ΄ L   | 298.76  | 309.83  | 311.44   | 303.3  | 277.13   | 210.25   | 143.35                                 | 150.09  | 221.05   | 266.85   | 279.77   | 288.3  |                          | (95)   |
|   | -   |   | ernal tem  |  |  |  | 1                                      |   | 1  |  |  |  | I                        |  |
| (96)m=  | 4.3   | 4.9   | 6.5  | 8.9  | 11.7   | 14.6   | 16.6                                   | 16.4  | 14.1   | 10.6   | 7.1  | 4.2  |                          | (96)   |
|   |   |   | an intern  |  |  | i  | · · ·                                  |   | <u>,                                    </u>             | -<br>1   |  |  | I                        |  |
| ι ΄ L   | 585.17  | 564.34  | 508.47   | 420.99   | 323.09   | 216.68   | 143.84                                 | 150.81  | 235.36   | 359.29   | 480.84   | 582.63   |                          | (97)   |
| · -   |   |   | ement fo   |  |  | 1  | 1                                      | 1   | í i  | <u>í - (</u>   | ,  | 040.00   | l                        |  |
| (98)m=  | 213.09  | 171.03  | 146.58   | 84.74  | 34.19  | 0  | 0                                      | 0   | 0  | 68.78  | 144.77   | 218.98   |                          |  |
|   |   |   |  |  |  |  |  | l ota   | l per year   | (kWh/year  | ) = Sum(9  | 8)15,912 =   | 1082.17                  | (98)   |
| Space   | heatin  | g require   | ement in   | kWh/m <sup>2</sup>   | /year  |  |  |   |  |  |  |  | 20.93                    | (99)   |
| 9a. Ene   | rgy rec   | uiremer   | nts – Indi   | ividu <mark>al h</mark>  | eating s   | yst <mark>ems</mark> i                             | ncluding                               | micro-C   | HP)  |  |  |  |                          |  |
| Sp <mark>ace</mark>   | heatir  | ng:   |  |  |  |  |  |   |  |  |  |  |                          | _  |
| Fractic   | on of sp  | ace h <mark>e</mark> a  | at from s  | econdar  | y/supple   | mentary  | system                                 |   |  |  |  |  | 0                        | (201)  |
| Fractio   |   |   |  |  |  |  |  |   |  |  |  |  |                          |  |
| Fractic   | on of sp  | ace hea   | at from m  | nain syst  | em(s)  |  |  | (202) = 1 ·                                     | – (201) =  |  |  |  | 1                        | (202)  |
|   |   |   | at from m<br>ng from   |  |  |  |  |   | - (201) =<br>02) × [1 -                                  | (203)] =   |  |  | 1                        | (202)<br>(204)   |
| Fractic   | on of to  | tal heati   |  | main sys   | stem 1   |  |  |   |  | (203)] =   |  |  |                          |  |
| Fractic<br>Efficier   | on of to<br>ncy of r  | tal heati<br>nain spa   | ng from  | main sys   | stem 1<br>em 1   | g system   |  |   |  | (203)] =   |  |  | 1                        | (204)  |
| Fractic<br>Efficier   | on of to<br>ncy of r<br>ncy of s  | tal heati<br>nain spa<br>seconda  | ng from<br>ace heat<br>iry/supple  | main sys<br>ing syste<br>ementar   | stem 1<br>em 1<br>y heating  |  | n, %                                   | (204) = (2                                      | 02) × [1 –   |  | Nov  | Dec  | 1<br>89.9<br>0           | (204)<br>(206)<br>(208)  |
| Fractic<br>Efficier<br>Efficier   | on of to<br>ncy of r<br>ncy of s<br>Jan   | tal heati<br>main spa<br>seconda<br>Feb   | ng from<br>ace heat<br>ry/supple<br>Mar  | main sys<br>ing syste<br>ementar<br>Apr  | stem 1<br>em 1<br>y heating<br>May   | Jun  |  |   |  | (203)] =<br>Oct  | Nov  | Dec  | 1<br>89.9                | (204)<br>(206)<br>(208)  |
| Fractic<br>Efficier<br>Efficier<br>Space  | on of to<br>ncy of r<br>ncy of s<br>Jan   | tal heati<br>main spa<br>seconda<br>Feb   | ng from<br>ace heat<br>iry/supple  | main sys<br>ing syste<br>ementar<br>Apr  | stem 1<br>em 1<br>y heating<br>May   | Jun  | n, %                                   | (204) = (2                                      | 02) × [1 –   |  | Nov<br>144.77  | Dec<br>218.98                                      | 1<br>89.9<br>0           | (204)<br>(206)<br>(208)  |
| Fractic<br>Efficier<br>Efficier<br>Space  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09   | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03  | ng from<br>ace heat<br>ry/supple<br>Mar<br>ement (c<br>146.58  | main syste<br>ementar<br>Apr<br>alculate<br>84.74  | stem 1<br>em 1<br>y heating<br>May<br>d above<br>34.19   | Jun  | n, %<br>Jul                            | (204) = (2<br>Aug                               | 02) × [1 –   | Oct  |  |  | 1<br>89.9<br>0           | (204)<br>(206)<br>(208)<br>ear                                     |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20  | ng from<br>ace heat<br>ry/supple<br>Mar<br>ement (c<br>146.58<br>(4)] } x 1  | main syste<br>ementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20  | stem 1<br>em 1<br>y heating<br>May<br>d above<br>34.19<br>06)                                    | Jun<br>)<br>0                                      | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0                          | 02) × [1 -<br>Sep<br>0                                   | Oct<br>68.78   | 144.77   | 218.98   | 1<br>89.9<br>0           | (204)<br>(206)<br>(208)  |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09   | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03  | ng from<br>ace heat<br>ry/supple<br>Mar<br>ement (c<br>146.58  | main syste<br>ementar<br>Apr<br>alculate<br>84.74  | stem 1<br>em 1<br>y heating<br>May<br>d above<br>34.19   | Jun  | n, %<br>Jul                            | (204) = (2<br>Aug<br>0                          | 02) × [1 -<br>Sep<br>0                                   | Oct<br>68.78<br>76.5   | 144.77<br>161.04   | 218.98<br>243.58                                   | 0<br>kWh/ye              | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20<br>190.25  | ng from<br>ace heat<br>ry/supple<br>Mar<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05  | main systementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20<br>94.26  | stem 1<br>em 1<br>y heating<br>May<br>d above<br>34.19<br>06)<br>38.03                           | Jun<br>)<br>0                                      | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0                          | 02) × [1 -<br>Sep<br>0                                   | Oct<br>68.78<br>76.5   | 144.77<br>161.04   | 218.98<br>243.58                                   | 1<br>89.9<br>0           | (204)<br>(206)<br>(208)<br>ear                                     |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s   | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar  | main systementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/  | stem 1<br>em 1<br>y heating<br>May<br>d above<br>34.19<br>06)<br>38.03                           | Jun<br>)<br>0                                      | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0                          | 02) × [1 -<br>Sep<br>0                                   | Oct<br>68.78<br>76.5   | 144.77<br>161.04   | 218.98<br>243.58                                   | 0<br>kWh/ye              | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>Space<br>= {[(98)]  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s   | ng from<br>ace heat<br>ry/supple<br>Mar<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05  | main systementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/  | stem 1<br>em 1<br>y heating<br>May<br>d above<br>34.19<br>06)<br>38.03                           | Jun<br>)<br>0                                      | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0                          | 02) × [1 -<br>Sep<br>0                                   | Oct<br>68.78<br>76.5   | 144.77<br>161.04   | 218.98<br>243.58                                   | 0<br>kWh/ye              | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20   | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s<br>01)] } x 1   | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20  | main syste<br>ementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)   | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month                         | Jun           0           0                        | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0<br>Tota                  | 02) × [1 -<br>Sep<br>0<br>1 (kWh/yea                     | Oct<br>68.78<br>76.5<br>ar) =Sum(2                                       | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0   | 218.98<br>243.58<br>=<br>0                         | 0<br>kWh/ye              | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>(211)m<br>(215)m=   | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20<br>0  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s<br>01)] } x 1<br>0  | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20  | main syste<br>ementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)   | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month                         | Jun           0           0                        | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0<br>Tota                  | 02) × [1 -<br>Sep<br>0<br>1 (kWh/yea                     | Oct<br>68.78<br>76.5<br>ar) =Sum(2                                       | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0   | 218.98<br>243.58<br>=<br>0                         | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)                            |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>(211)m<br>(215)m=<br>Water h  | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20<br>0  | tal heati<br>nain spa<br>seconda<br><u>Feb</u><br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s<br>01)] } x 1<br>0   | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20<br>0   | main systementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)<br>0   | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month<br>0                    | Jun           0           0                        | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0<br>Tota                  | 02) × [1 -<br>Sep<br>0<br>1 (kWh/yea                     | Oct<br>68.78<br>76.5<br>ar) =Sum(2                                       | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0   | 218.98<br>243.58<br>=<br>0                         | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>(211)m<br>Space<br>= {[(98)r<br>(215)m=<br>Water h<br>Output f                                    | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20<br>0  | tal heati<br>nain spa<br>seconda<br><u>Feb</u><br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s<br>01)] } x 1<br>0   | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20  | main systementar<br>Apr<br>alculate<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)<br>0   | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month<br>0                    | Jun           0           0                        | n, %<br>Jul<br>0                       | (204) = (2<br>Aug<br>0<br>Tota                  | 02) × [1 -<br>Sep<br>0<br>1 (kWh/yea                     | Oct<br>68.78<br>76.5<br>ar) =Sum(2                                       | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0   | 218.98<br>243.58<br>=<br>0                         | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>(211)m<br>Space<br>= {[(98)r<br>(215)m=<br>Water h<br>Output f                                    | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20<br>0<br>neating<br>from wa<br>134.98  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>(m x (20<br>190.25<br>g fuel (s<br>0)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s  | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20<br>0<br>ter (calc<br>122.94  | main systementar<br>Apr<br>alculated<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)<br>0  | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month<br>0                    | Jun           0           0           0            | n, % Jul 0                             | (204) = (2<br>Aug<br>0<br>Tota                  | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea                  | Oct<br>68.78<br>76.5<br>ar) =Sum(2<br>0<br>ar) =Sum(2                    | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 218.98<br>243.58<br>=<br>0                         | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)                   |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>(211)m<br>Space<br>= {[(98)r<br>(215)m=<br>Water H<br>Output f                                    | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20<br>0<br>neating<br>from wa<br>134.98  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>(m x (20<br>190.25<br>g fuel (s<br>0)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s)<br>(s  | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20<br>0<br>ter (calc<br>122.94  | main systementar<br>Apr<br>alculated<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)<br>0  | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month<br>0                    | Jun           0           0           0            | n, % Jul 0                             | (204) = (2<br>Aug<br>0<br>Tota                  | 02) × [1<br>Sep<br>0<br>0<br>I (kWh/yea                  | Oct<br>68.78<br>76.5<br>ar) =Sum(2<br>0<br>ar) =Sum(2                    | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>                    | 218.98<br>243.58<br>=<br>0                         | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)          |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>(211)m<br>(215)m=<br>Water H<br>Output f<br>Efficier<br>(217)m=                                   | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>$= \{[(98)$<br>237.03<br>heatin<br>m x (20<br>0<br>neating<br>from wa<br>134.98<br>cy of w<br>88.63  | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s<br>190.25<br>g fuel (s<br>190.25<br>g fuel (s<br>190.25<br>g fuel (s<br>190.25<br>g fuel (s<br>190.25<br>g fuel (s<br>190.25  | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20<br>0<br>0<br>ter (calc<br>122.94<br>ater   | main systementar<br>Apr<br>alculated<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)<br>0<br>ulated al<br>108.29<br>88.08              | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month<br>0<br>104.74          | Jun       0       0       0       91.59            | n, %<br>Jul<br>0<br>0<br>86.07         | (204) = (2<br>Aug<br>0<br>Tota<br>97.06         | 02) × [1<br>Sep<br>0<br>0<br>1 (kWh/yea<br>97.71         | Oct<br>68.78<br>76.5<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>112.39          | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>121.25          | 218.98<br>243.58<br>=<br>0<br>=<br>131.09          | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Fractic<br>Efficien<br>Efficien<br>Space<br>(211)m<br>(211)m<br>(215)m=<br>Water H<br>Output f<br>Cutput f<br>Efficien<br>(217)m=<br>Fuel for<br>(219)m | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20<br>0<br>heatin<br>m x (20<br>0<br>heatin<br>g<br>from wa<br>134.98<br>cy of w<br>88.63<br>water<br>= (64) | tal heati<br>main spa<br>seconda<br>Feb<br>g require<br>171.03<br>(m x (20)<br>190.25<br>g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>190.25<br>(g fuel (s<br>118.38<br>(g fuel heating,<br>m x 100)  | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] $\}$ x 1<br>163.05<br>econdar<br>00 $\div$ (20<br>0<br>0<br>0<br>$\pm$ (20<br>0<br>ter (calc<br>122.94<br>ater<br>88.41<br>kWh/mc<br>$0 \div$ (217) | main systementar<br>Apr<br>alculated<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)<br>0<br>ulated al<br>108.29<br>88.08<br>onth<br>m | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month<br>0<br>104.74<br>87.47 | Jun       0       0       0       91.59       86.7 | n, %<br>Jul<br>0<br>0<br>86.07<br>86.7 | (204) = (2<br>Aug<br>0<br>Tota<br>97.06<br>86.7 | 02) × [1<br>Sep<br>0<br>0<br>1 (kWh/yea<br>97.71<br>86.7 | Oct<br>68.78<br>76.5<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>112.39<br>87.89 | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>121.25<br>88.41 | 218.98<br>243.58<br>=<br>0<br>=<br>131.09<br>88.67 | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |
| Fractic<br>Efficier<br>Efficier<br>Space<br>(211)m<br>(211)m<br>(215)m=<br>Water H<br>Output f<br>Efficier<br>(217)m=<br>Fuel for<br>(219)m             | on of to<br>ncy of r<br>ncy of s<br>Jan<br>heatin<br>213.09<br>= {[(98<br>237.03<br>heatin<br>m x (20<br>0<br>heatin<br>m x (20<br>0<br>heatin<br>g<br>from wa<br>134.98<br>cy of w<br>88.63<br>water<br>= (64) | tal heati<br>nain spa<br>seconda<br>Feb<br>g require<br>171.03<br>)m x (20<br>190.25<br>g fuel (s<br>190.25<br>g  fuel (s<br>190.2 | ng from<br>ace heat<br>ry/supple<br>ement (c<br>146.58<br>(4)] } x 1<br>163.05<br>econdar<br>00 ÷ (20<br>0<br>0<br>ter (calc<br>122.94<br>ater<br>88.41<br>kWh/mc  | main systementar<br>Apr<br>alculated<br>84.74<br>00 ÷ (20<br>94.26<br>y), kWh/<br>8)<br>0<br>ulated al<br>108.29<br>88.08<br>onth      | stem 1<br>em 1<br>y heating<br>d above<br>34.19<br>06)<br>38.03<br>month<br>0<br>104.74          | Jun       0       0       0       91.59            | n, %<br>Jul<br>0<br>0<br>86.07         | (204) = (2<br>Aug<br>0<br>Tota<br>97.06<br>86.7 | 02) × [1<br>Sep<br>0<br>0<br>1 (kWh/yea<br>97.71         | Oct<br>68.78<br>76.5<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>112.39<br>87.89 | 144.77<br>161.04<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>121.25          | 218.98<br>243.58<br>=<br>0<br>=<br>131.09          | 1<br>89.9<br>0<br>kWh/ye | (204)<br>(206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211)<br>(215) |

| Annual totals                                     |                                 | kWh/year                          |        | kWh/year                       | _      |
|---|---------------------------------|-----------------------------------|--------|--------------------------------|--------|
| Space heating fuel used, main system 1            |                                 |                                   |        | 1203.75                        |        |
| Water heating fuel used                           |                                 |                                   |        | 1510.16                        | ]      |
| Electricity for pumps, fans and electric keep-hot |                                 |                                   |        |                                |        |
| mechanical ventilation - balanced, extract or po  | ositive input from outside      |                                   | 121.42 |                                | (230a) |
| central heating pump:                             |                                 |                                   | 30     |                                | (230c) |
| boiler with a fan-assisted flue                   |                                 |                                   | 45     |                                | (230e) |
| Total electricity for the above, kWh/year         | sum of (230                     | a)(230g) =                        |        | 196.42                         | (231)  |
| Electricity for lighting                          |                                 |                                   |        | 322.17                         | (232)  |
| 12a. CO2 emissions - Individual heating system    | ms including micro-CHP          |                                   |        |                                |        |
|   | <b>Energy</b><br>kWh/year       | <b>Emission fac</b><br>kg CO2/kWh | tor    | <b>Emissions</b><br>kg CO2/yea | r      |
| Space heating (main system 1)                     | (211) x                         | 0.216                             | =      | 260.01                         | (261)  |
| Space heating (secondary)                         | (215) x                         | 0.519                             | =      | 0                              | (263)  |
| Water heating                                     | (219) x                         | 0.216                             | =      | 326.19                         | (264)  |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                                   |        | 586.2                          | (265)  |

(231) x

(232) x

0.519

0.519

sum of (265)...(271) =

(272) ÷ (4) =

101.94

167.21

8<mark>55.35</mark>

16.54

88

(267)

(268)

(272)

(273)

(274)

Electricity for pumps, fans and electric keep-hot

Electricity for lighting

Total CO2, kg/year

El rating (section 14)

Dwelling CO2 Emission Rate

|   |                               |                         | User D           | etails:          |                |                 |                       |           |                                   |              |
|---|-------------------------------|-------------------------|------------------|------------------|----------------|-----------------|-----------------------|-----------|-----------------------------------|--------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 201               |                         |                  | Stroma<br>Softwa | re Ver         |                 |                       | Versio    | n: 1.0.4.23                       |              |
|   | 2 Bed Flat, 219-223           |                         |                  | Address:         |                | nh lunat        | ion I ON              |           |                                   |              |
| Address :<br>1. Overall dwelling dimer  |                               | Colunan                 | Jour La          | ne, Loug         | μοιοαί         | gn Junci        | ION, LOP              | NDON      |                                   |              |
| Ground floor  |                               |                         | Area             | . ,              | (1a) x         | Av. Hei         | <b>ight(m)</b><br>2.5 | (2a) =    | Volume(m <sup>3</sup> )<br>194.75 | (3a)         |
| Total floor area TFA = (1a  | )+(1b)+(1c)+(1d)+(1e          | e)+(1n)                 | ) 7              | 7.9              | (4)            |                 |                       |           |                                   |              |
| Dwelling volume   |                               |                         |                  |                  | (3a)+(3b)      | +(3c)+(3d       | l)+(3e)+              | .(3n) =   | 194.75                            | (5)          |
| 2. Ventilation rate:  |                               |                         |                  |                  |                |                 |                       |           |                                   |              |
| Number of chimneys  | heating h                     | econdary<br>neating     | / ·              | other            | 1 = [          | total           | x 4                   | 40 =      | m <sup>3</sup> per hour           | -            |
| Number of open flues  |                               | 0                       | ] ' [_<br>] + [_ | 0                | ] - L<br>] = Г | 0               |                       | 20 =      | 0                                 | (6a)<br>(6b) |
| Number of intermittent fan  | IS L                          |                         |                  |                  | 」<br>「         | 0               | <b>x</b> 1            | 10 =      | 0                                 | (7a)         |
| Number of passive vents   |                               |                         |                  |                  | F              | 0               | x 1                   | 10 =      | 0                                 | (7b)         |
| Number of flueless gas fire   | es                            |                         |                  |                  |                | 0               | x 4                   | 40 =      | 0                                 | (7c)         |
|   |                               |                         |                  |                  |                |                 |                       | Air ch    | ange <mark>s per</mark> ho        | ur           |
| Infiltration due to chimney   |                               |                         |                  |                  |                | 0               |                       | ÷ (5) =   | 0                                 | (8)          |
| If a pressurisation test has be<br>Number of storeys in the<br>Additional infiltration      | e dw <mark>elling</mark> (ns) |                         |                  |                  |                |                 |                       | -1]x0.1 = | 0                                 | (9)<br>(10)  |
| Structural infiltration: 0.2<br>if both types of wall are pre<br>deducting areas of opening | esent, use the value corres   |                         |                  |                  | •              | uction          |                       |           | 0                                 | (11)         |
| If suspended wooden flo   |                               | led) or 0. <sup>-</sup> | 1 (seale         | d), else         | enter 0        |                 |                       |           | 0                                 | (12)         |
| If no draught lobby, ente   | er 0.05, else enter 0         |                         |                  |                  |                |                 |                       |           | 0                                 | (13)         |
| Percentage of windows   | and doors draught st          | tripped                 |                  |                  |                |                 |                       |           | 0                                 | (14)         |
| Window infiltration   |                               |                         |                  | 0.25 - [0.2      | x (14) ÷ 1     | = [00           |                       |           | 0                                 | (15)         |
| Infiltration rate   |                               |                         |                  | (8) + (10) -     |                |                 |                       |           | 0                                 | (16)         |
| Air permeability value, o   |                               |                         | •                | •                |                | etre of e       | nvelope               | area      | 2                                 | (17)         |
| If based on air permeabilit   |                               |                         |                  |                  |                | :- <b>b</b> - : |                       |           | 0.1                               | (18)         |
| Air permeability value applies<br>Number of sides sheltered                                 |                               | s been done             | e or a deg       | iree all per     | meaning        | is being us     | seu                   | I         | 2                                 | (19)         |
| Shelter factor  | ~                             |                         |                  | (20) = 1 - [     | 0.075 x (1     | 9)] =           |                       |           | 0.85                              | (20)         |
| Infiltration rate incorporation   | ng shelter factor             |                         |                  | (21) = (18)      | x (20) =       |                 |                       |           | 0.08                              | (21)         |
| Infiltration rate modified fo   | r monthly wind speed          | b                       |                  |                  |                |                 |                       | Į         |                                   |              |
| Jan Feb I   | Mar Apr May                   | Jun                     | Jul              | Aug              | Sep            | Oct             | Nov                   | Dec       |                                   |              |
| Monthly average wind spe  | ed from Table 7               |                         |                  |                  |                |                 |                       |           |                                   |              |
| (22)m= 5.1 5 4  | 4.9 4.4 4.3                   | 3.8                     | 3.8              | 3.7              | 4              | 4.3             | 4.5                   | 4.7       |                                   |              |
| Wind Factor (22a)m = (22  | )m ÷ 4                        |                         |                  |                  |                |                 |                       |           |                                   |              |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08                  | 0.95                    | 0.95             | 0.92             | 1              | 1.08            | 1.12                  | 1.18      |                                   |              |

| Adjust   | ed infiltr             | ation rat | e (allow                  | ing for sh                  | nelter an   | d wind s    | peed) =        | (21a) x                               | (22a)m       |             |             |           |            |                |
|----------|------------------------|-----------|---------------------------|-----------------------------|-------------|-------------|----------------|---------------------------------------|--------------|-------------|-------------|-----------|------------|----------------|
|          | 0.11                   | 0.11      | 0.1                       | 0.09                        | 0.09        | 0.08        | 0.08           | 0.08                                  | 0.08         | 0.09        | 0.1         | 0.1       |            |                |
|          | ate ette<br>echanica   |           | -                         | rate for t                  | he appli    | cable ca    | se             |                                       |              |             |             |           | 0.5        | (23a)          |
|          |                        |           |                           | endix N, (2                 | 3b) = (23a  | ı) × Fmv (e | equation (I    | N5)) . othe                           | rwise (23b   | ) = (23a)   |             |           | 0.5<br>0.5 | (23a)<br>(23b) |
|          |                        |           |                           | iency in %                  |             |             |                |                                       |              | , ( ,       |             |           | 73.1       | (23c)          |
|          |                        |           |                           |                             | 0           |             |                |                                       | ,            | 2h)m + (    | 23h) x [    | 1 – (23c) | -          | (200)          |
| (24a)m=  |                        | 0.24      | 0.24                      | 0.23                        | 0.23        | 0.22        | 0.22           | 0.21                                  | 0.22         | 0.23        | 0.23        | 0.23      | . 100]     | (24a)          |
|          |                        | d mech    | L<br>anical ve            | I<br>entilation             | without     | heat rec    | L<br>coverv (N | L<br>MV) (24h                         | (22)         | L2b)m + ()  | L<br>23b)   |           |            |                |
| (24b)m=  | r                      | 0         | 0                         | 0                           | 0           | 0           | 0              | 0                                     | 0            | 0           | 0           | 0         |            | (24b)          |
|          |                        | use ex    | tract ver                 | ntilation of                | or positiv  | re input v  | ventilatio     | n from o                              | utside       |             |             |           |            |                |
| ,        |                        |           |                           | then (24                    | •           | •           |                |                                       |              | .5 × (23b   | <b>)</b> )  |           |            |                |
| (24c)m=  | - 0                    | 0         | 0                         | 0                           | 0           | 0           | 0              | 0                                     | 0            | 0           | 0           | 0         |            | (24c)          |
| ,        |                        |           |                           | ole hous                    |             | •           |                |                                       |              | -           | -           |           |            |                |
|          | <u>, ,</u>             | r         | r , ,                     | m = (22                     | <i>.</i>    | <u>`</u>    | ,<br>          | <u> </u>                              | <u> </u>     | 0.5]        |             |           | l          |                |
| (24d)m=  | 0                      | 0         | 0                         | 0                           | 0           | 0           | 0              | 0                                     | 0            | 0           | 0           | 0         |            | (24d)          |
|          |                        |           | î .                       | nter (24a                   | , <u>,</u>  | , <u> </u>  | , <u>,</u>     | · · · · · · · · · · · · · · · · · · · | 1 Ó          |             | i           | i         | I          |                |
| (25)m=   | 0.24                   | 0.24      | 0.24                      | 0.23                        | 0.23        | 0.22        | 0.22           | 0.21                                  | 0.22         | 0.23        | 0.23        | 0.23      |            | (25)           |
| 3. He    | at l <mark>osse</mark> | s and he  | eat loss                  | paramete                    | er:         |             |                |                                       |              |             |             |           |            |                |
|          | /IENT                  | Gro       |                           | Openin                      |             | Net Ar      |                | U-val                                 |              | AXU         |             | k-value   |            | AXk            |
| 10/200 - | т                      | area      | (m²)                      | m                           | 12          | A ,n        |                | W/m2                                  |              | (VV/I       | K)          | kJ/m²·ł   | ς          | kJ/K           |
|          | ws Type                |           |                           |                             |             | 9.45        |                | /[1/( 0.73 )-                         |              | 6.7         |             |           |            | (27)           |
|          | ws Type                |           |                           |                             |             | 3.15        | ×1/            | /[1/( 0.73 )-                         | + 0.04] =    | 2.23        | ╘╴,         |           |            | (27)           |
| Walls    |                        | 10.0      | 05                        | 9.45                        |             | 0.6         | ×              | 0.15                                  | =            | 0.09        | L ļ         |           | ╡┝         | (29)           |
| Walls    |                        | 14.       | 5                         | 0                           |             | 14.5        | ×              | 0.15                                  | =            | 2.18        |             |           | $\_$ $\_$  | (29)           |
| Walls    |                        | 5.3       |                           | 3.15                        |             | 2.2         | x              | 0.15                                  | =            | 0.33        |             |           |            | (29)           |
| Total a  | area of e              | lements   | s, m²                     |                             |             | 29.9        |                |                                       |              |             |             |           |            | (31)           |
| Party    | wall                   |           |                           |                             |             | 32          | x              | 0                                     | =            | 0           |             |           |            | (32)           |
| Party    | wall                   |           |                           |                             |             | 33          | x              | 0                                     | =            | 0           |             |           |            | (32)           |
| Party f  | loor                   |           |                           |                             |             | 77.9        |                |                                       |              |             | [           |           |            | (32a)          |
| Party of | ceiling                |           |                           |                             |             | 77.9        |                |                                       |              |             | [           |           |            | (32b)          |
| Interna  | al wall **             |           |                           |                             |             | 82.5        |                |                                       |              |             | [           |           |            | (32c)          |
|          |                        |           |                           | effective wi<br>nternal wal |             |             | ated using     | g formula 1                           | /[(1/U-valı  | ıe)+0.04] a | as given in | paragraph | 3.2        |                |
| Fabric   | heat los               | s, W/K    | = S (A x                  | U)                          |             |             |                | (26)(30)                              | ) + (32) =   |             |             |           | 11.53      | (33)           |
| Heat c   | apacity                | Cm = S    | (A x k )                  |                             |             |             |                |                                       | ((28).       | (30) + (32  | 2) + (32a). | (32e) =   | 15893.     | 1 (34)         |
| Therm    | al mass                | parame    | eter (TMI                 | <sup>-</sup> = Cm ÷         | - TFA) in   | n kJ/m²K    |                |                                       | Indica       | tive Value  | : Medium    |           | 250        | (35)           |
|          | -                      |           | ere the de<br>tailed calc | etails of the<br>ulation.   | constructi  | ion are not | t known pi     | recisely the                          | e indicative | e values of | TMP in T    | able 1f   |            |                |
| Therm    | al bridg               | es : S (L | x Y) cal                  | culated (                   | using Ap    | pendix ł    | <              |                                       |              |             |             |           | 6.02       | (36)           |
|          |                        |           | are not kr                | nown (36) =                 | = 0.05 x (3 | 1)          |                |                                       | (0.0)        | (0.0)       |             | 1         |            | <b></b> .      |
| i otal f | abric he               | at IOSS   |                           |                             |             |             |                |                                       | (33) +       | (36) =      |             |           | 17.55      | (37)           |

| Ventila   | ation hea          | at loss ca          | alculated         | monthl                   | у                |                    |                   |                    | (38)m        | = 0.33 × (           | 25)m x (5)             |           |         |      |
|-----------|--------------------|---------------------|-------------------|--------------------------|------------------|--------------------|-------------------|--------------------|--------------|----------------------|------------------------|-----------|---------|------|
|           | Jan                | Feb                 | Mar               | Apr                      | May              | Jun                | Jul               | Aug                | Sep          | Oct                  | Nov                    | Dec       |         |      |
| (38)m=    | 15.61              | 15.47               | 15.34             | 14.65                    | 14.52            | 13.83              | 13.83             | 13.7               | 14.11        | 14.52                | 14.79                  | 15.06     |         | (38) |
| Heat tr   | ransfer o          | coefficie           | nt, W/K           |                          |                  |                    |                   |                    | (39)m        | = (37) + (           | 38)m                   |           |         |      |
| (39)m=    | 33.16              | 33.03               | 32.89             | 32.21                    | 32.07            | 31.39              | 31.39             | 31.25              | 31.66        | 32.07                | 32.34                  | 32.62     |         |      |
|           |                    |                     |                   |                          |                  |                    |                   | -                  |              |                      | Sum(39)1.              | 12 /12=   | 32.17   | (39) |
|           | <u> </u>           | · · ·               | HLP), W           | 1                        |                  |                    |                   |                    | · · ·        | = (39)m ÷            |                        |           |         |      |
| (40)m=    | 0.43               | 0.42                | 0.42              | 0.41                     | 0.41             | 0.4                | 0.4               | 0.4                | 0.41         | 0.41                 | 0.42                   | 0.42      | 0.44    |      |
| Numbe     | er of day          | s in mo             | nth (Tab          | le 1a)                   |                  |                    |                   |                    | ,            | <pre>average =</pre> | Sum(40)1.              | 12 / 1 Z= | 0.41    | (40) |
|           | Jan                | Feb                 | Mar               | Apr                      | May              | Jun                | Jul               | Aug                | Sep          | Oct                  | Nov                    | Dec       |         |      |
| (41)m=    | 31                 | 28                  | 31                | 30                       | 31               | 30                 | 31                | 31                 | 30           | 31                   | 30                     | 31        |         | (41) |
|           |                    |                     | !                 | ļ                        | !                | !                  | !                 | ļ                  |              |                      |                        | I         |         |      |
| 4 Wa      | ater heat          | tina ener           | rav reau          | irement:                 |                  |                    |                   |                    |              |                      |                        | kWh/ye    | ar.     |      |
|           |                    | ing ono             | igy ioqu          |                          |                  |                    |                   |                    |              |                      |                        |           |         |      |
|           |                    |                     |                   | [1 ovp                   | ( 0 0003         |                    | - 120             | )2)] + 0.(         | 1012 v (*    | FEA 12               |                        | 42        |         | (42) |
|           | A £ 13.9           |                     | + 1.70 X          | r [i - exh               | (-0.0003         | 949 X (11          | A -13.9           | <i>)</i> 2)] + 0.0 | JU13 X (     | IFA - 13.            | .9)                    |           |         |      |
|           |                    |                     |                   |                          |                  |                    |                   | (25 x N)           |              |                      |                        | .72       |         | (43) |
|           |                    | -                   |                   | usage by<br>r day (all w |                  | -                  | -                 | to achieve         | a water us   | se target o          | f                      |           |         |      |
|           | _                  |                     |                   |                          |                  |                    | ·                 |                    | 0.00         | Ort                  | Neu                    | Dea       |         |      |
| Hot wate  | Jan<br>er usage ii | Feb<br>n litres per | Mar<br>day for ea | Apr<br>ach month         | May<br>Vd.m.= fa | Jun<br>ctor from T | Jul<br>Table 1c x | Aug (43)           | Sep          | Oct                  | Nov                    | Dec       |         |      |
| (44)m=    | 100.89             | ,<br>97.22          | 93.55             | 89.88                    | 86.21            | 82.55              | 82.55             | 86.21              | 89.88        | 9 <mark>3.55</mark>  | 97.22                  | 100.89    |         |      |
| (44)111-  | 100.09             | 51.22               | 90.00             | 03.00                    | 00.21            | 02.00              | 02.00             | 00.21              |              |                      | m(44) <sub>112</sub> = |           | 1100.62 | (44) |
| Energy (  | content of         | hot water           | used - ca         | lculated m               | onthly $= 4$ .   | 190 x Vd,r         | n x nm x E        | 0Tm / 3600         |              |                      | bles 1b, 1             |           |         |      |
| (45)m=    | 149.62             | 130.86              | 135.03            | 117.72                   | 112.96           | 97.47              | 90.32             | 103.65             | 104.89       | 122.24               | 133.43                 | 144.9     |         |      |
|           |                    |                     |                   |                          |                  |                    |                   |                    |              | Fotal = Su           | m(45) <sub>112</sub> = | -         | 1443.08 | (45) |
| lf instan | taneous w          | ater heati          | ng at point       | t of use (no             | o hot water      | r storage),        | enter 0 in        | boxes (46          | ) to (61)    |                      | -                      |           |         |      |
|           | 22.44              |                     | 20.25             | 17.66                    | 16.94            | 14.62              | 13.55             | 15.55              | 15.73        | 18.34                | 20.01                  | 21.73     |         | (46) |
|           | storage            |                     | includir          |                          | alar ar M        | /\//HBC            | storada           | within sa          | me ves       | ما                   |                        | 0         |         | (47) |
| -         |                    | . ,                 |                   | ank in dw                |                  |                    | -                 |                    |              | 501                  |                        | 0         |         | (47) |
|           |                    | -                   |                   |                          | -                |                    |                   | ombi boil          | ers) ente    | er '0' in (          | 47)                    |           |         |      |
|           | storage            |                     |                   | ,                        |                  |                    |                   |                    | ,            | ·                    |                        |           |         |      |
| a) If m   | nanufact           | urer's de           | eclared I         | oss facto                | or is kno        | wn (kWł            | n/day):           |                    |              |                      |                        | 0         |         | (48) |
| Tempe     | erature f          | actor fro           | m Table           | 2b                       |                  |                    |                   |                    |              |                      |                        | 0         |         | (49) |
|           |                    |                     | -                 | e, kWh/ye                |                  |                    |                   | (48) x (49)        | ) =          |                      |                        | 0         |         | (50) |
| ,         |                    |                     |                   | cylinder l<br>rom Tabl   |                  |                    |                   |                    |              |                      |                        | 0         |         | (54) |
|           |                    | -                   | ee secti          |                          |                  | n/nuc/uc           | iy)               |                    |              |                      |                        | 0         |         | (51) |
|           | e factor           | -                   |                   |                          |                  |                    |                   |                    |              |                      |                        | 0         |         | (52) |
| Tempe     | erature f          | actor fro           | m Table           | 2b                       |                  |                    |                   |                    |              |                      |                        | 0         |         | (53) |
| Energy    | y lost fro         | m water             | storage           | e, kWh/ye                | ear              |                    |                   | (47) x (51)        | ) x (52) x ( | 53) =                |                        | 0         |         | (54) |
| Enter     | (50) or (          | (54) in (5          | 55)               |                          |                  |                    |                   |                    |              |                      |                        | 0         |         | (55) |
| Water     | storage            | loss cal            | culated           | for each                 | month            |                    |                   | ((56)m = (         | 55) × (41)   | m                    |                        |           |         |      |
| (56)m=    | 0                  | 0                   | 0                 | 0                        | 0                | 0                  | 0                 | 0                  | 0            | 0                    | 0                      | 0         |         | (56) |

| If cylinder contain          | s dedicated             | d solar sto | rage, (57)r             | m = (56)m | x [(50) – ( | H11)] ÷ (5               | 0), else (5  | 7)m = (56)    | m where (                 | H11) is fro   | m Append    | lix H         |      |
|------------------------------|-------------------------|-------------|-------------------------|-----------|-------------|--------------------------|--------------|---------------|---------------------------|---------------|-------------|---------------|------|
| (57)m= 0                     | 0                       | 0           | 0                       | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           |               | (57) |
| Primary circuit              | t loss (an              | nual) fro   | om Table                | 93        |             |                          |              |               |                           |               | 0           |               | (58) |
| Primary circuit              | •                       | ,           |                         |           | 59)m = (    | (58) ÷ 36                | 65 × (41)    | m             |                           |               |             |               |      |
| (modified by                 | / factor fr             | om Tab      | le H5 if t              | here is s | solar wat   | er heatir                | ng and a     | cylinde       | r thermo                  | stat)         |             |               |      |
| (59)m= 0                     | 0                       | 0           | 0                       | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           |               | (59) |
| Combi loss ca                | lculated f              | for each    | month (                 | 61)m =    | (60) ÷ 36   | 65 × (41)                | )m           |               |                           |               |             |               |      |
| (61)m= 11.84                 | 10.68                   | 11.81       | 11.4                    | 11.76     | 11.36       | 11.73                    | 11.75        | 11.38         | 11.79                     | 11.44         | 11.83       |               | (61) |
| Total heat req               | uired for               | water he    | eating ca               | alculated | l for eacl  | h month                  | (62)m =      | 0.85 × (      | (45)m +                   | (46)m +       | (57)m +     | (59)m + (61)r | n    |
| (62)m= 161.46                | 141.54                  | 146.84      | 129.12                  | 124.72    | 108.84      | 102.05                   | 115.4        | 116.27        | 134.02                    | 144.87        | 156.73      |               | (62) |
| Solar DHW input              | calculated u            | using App   | endix G or              | Appendix  | H (negati   | ve quantity              | /) (enter '0 | ' if no sola  | r contribut               | ion to wate   | er heating) |               |      |
| (add additiona               | al lines if I           | FGHRS       | and/or V                | VWHRS     | applies     | , see Ap                 | pendix C     | <u>3)</u>     |                           |               |             |               |      |
| (63)m= 0                     | 0                       | 0           | 0                       | 0         | 0           | 0                        | 0            | 0             | 0                         | 0             | 0           |               | (63) |
| Output from w                | ater heat               | ter         |                         |           |             |                          |              | -             | -                         | -             |             |               |      |
| (64)m= 161.46                | 141.54                  | 146.84      | 129.12                  | 124.72    | 108.84      | 102.05                   | 115.4        | 116.27        | 134.02                    | 144.87        | 156.73      |               | _    |
|                              |                         |             |                         |           |             |                          | Outp         | out from wa   | ater heate                | r (annual)₁   | 12          | 1581.85       | (64) |
| Heat gains fro               | m water                 | heating,    | kWh/mo                  | onth 0.2  | 5 ´ [0.85   | × (45)m                  | + (61)m      | n] + 0.8 >    | k [(46)m                  | + (57)m       | + (59)m     | ]             |      |
| (65)m= 52.71                 | 46.18                   | 47.85       | 41.99                   | 40.5      | 35.25       | 32.96                    | 37.4         | 37.72         | 43.59                     | 47.22         | 51.14       |               | (65) |
| in <mark>clude</mark> (57)   | m in c <mark>alc</mark> | ulation     | o <mark>f (6</mark> 5)m | only if c | ylinder is  | s in th <mark>e c</mark> | dwelling     | or hot w      | ate <mark>r is f</mark> r | om com        | munity h    | eating        |      |
| 5. Internal g                | ains (see               | Table 5     | and 5a)                 | ):        |             |                          |              |               |                           |               |             |               |      |
| Met <mark>abolic</mark> gair | ns (Table               | 5), Wat     | ts                      |           |             |                          |              |               |                           |               |             |               |      |
| Jan                          | Feb                     | Mar         | Apr                     | May       | Jun         | Jul                      | Aug          | Sep           | Oct                       | Nov           | Dec         |               |      |
| (66)m= 121.09                | 121.09                  | 121.09      | 121.09                  | 121.09    | 121.09      | 121.09                   | 121.09       | 121.09        | 121.09                    | 121.09        | 121.09      |               | (66) |
| Lighting gains               | (calculat               | ed in Ap    | pendix l                | _, equat  | ion L9 oi   | r L9a), a                | lso see      | Table 5       |                           |               |             |               |      |
| (67)m= 27.01                 | 23.99                   | 19.51       | 14.77                   | 11.04     | 9.32        | 10.07                    | 13.09        | 17.57         | 22.31                     | 26.04         | 27.76       |               | (67) |
| Appliances ga                | -                       |             |                         |           |             |                          | -            | see Ta        | ble 5                     |               |             |               |      |
| (68)m= 215                   | 217.23                  | 211.6       | 199.64                  | 184.53    | 170.33      | 160.84                   | 158.61       | 164.23        | 176.2                     | 191.31        | 205.51      |               | (68) |
| Cooking gains                | (calcula                | ted in A    | ppendix                 | L, equat  | ion L15     | or L15a)                 | ), also se   | e Table       | 5                         | -             |             |               |      |
| (69)m= 35.11                 | 35.11                   | 35.11       | 35.11                   | 35.11     | 35.11       | 35.11                    | 35.11        | 35.11         | 35.11                     | 35.11         | 35.11       |               | (69) |
| Pumps and fa                 | ns gains                | (Table 5    | ōa)                     |           |             |                          |              | -             | _                         |               |             |               |      |
| (70)m= 3                     | 3                       | 3           | 3                       | 3         | 3           | 3                        | 3            | 3             | 3                         | 3             | 3           |               | (70) |
| Losses e.g. ev               | aporatio                | n (negat    | tive valu               | es) (Tab  | le 5)       |                          |              |               |                           |               |             |               |      |
| (71)m= -96.87                | -96.87                  | -96.87      | -96.87                  | -96.87    | -96.87      | -96.87                   | -96.87       | -96.87        | -96.87                    | -96.87        | -96.87      |               | (71) |
| Water heating                | gains (T                | able 5)     |                         |           |             |                          |              |               |                           |               |             |               |      |
| (72)m= 70.84                 | 68.72                   | 64.31       | 58.32                   | 54.43     | 48.96       | 44.31                    | 50.27        | 52.39         | 58.59                     | 65.59         | 68.73       |               | (72) |
| Total internal               | gains =                 |             |                         |           | (66)        | m + (67)m                | n + (68)m +  | + (69)m + (   | (70)m + (7                | 1)m + (72)    | m           |               |      |
| (73)m= 375.17                | 372.26                  | 357.75      | 335.06                  | 312.33    | 290.94      | 277.55                   | 284.3        | 296.52        | 319.43                    | 345.26        | 364.33      |               | (73) |
| 6. Solar gain                | s:                      |             |                         |           |             |                          |              |               |                           |               |             |               |      |
| Solar gains are              | calculated u            | using sola  | r flux from             | Table 6a  | and associ  | iated equa               | tions to co  | onvert to th  | ie applicat               | le orientat   | ion.        |               |      |
| Orientation:                 | Access F<br>Table 6d    | actor       | Area<br>m²              |           | Flu<br>Tal  | x<br>ole 6a              | т            | g_<br>able 6b | Та                        | FF<br>able 6c |             | Gains<br>(W)  |      |

|                                       |              |                 |      |           |                 |       |                 |           | -     |              |              | _        | _   |       |     |     |       |      |
|---------------------------------------|--------------|-----------------|------|-----------|-----------------|-------|-----------------|-----------|-------|--------------|--------------|----------|-----|-------|-----|-----|-------|------|
| Northeast 0.9                         | •            |                 | x    | 3.1       | 5               | X     | 1               | 1.28      | ×     |              | 0.63         | >        | Ĺ   | 0.1   |     | =   | 1.55  | (75) |
| Northeast 0.9                         |              |                 | x    | 3.1       | 5               | x     | 2               | 2.97      | ×     |              | 0.63         | >        | Ľ   | 0.1   |     | =   | 3.16  | (75) |
| Northeast 0.9                         |              |                 | x    | 3.1       | 5               | x     | 4               | 1.38      | ×     |              | 0.63         | <b>`</b> | Ľ   | 0.1   |     | =   | 5.69  | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 6               | 57.96     | ×     |              | 0.63         | <b>)</b> |     | 0.1   |     | =   | 9.35  | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 9               | 1.35      | x     |              | 0.63         | >        | : [ | 0.1   |     | =   | 12.56 | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 9               | 7.38      | ×     |              | 0.63         | >        |     | 0.1   |     | =   | 13.39 | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 9               | 91.1      | ×     |              | 0.63         | >        | : [ | 0.1   |     | =   | 12.53 | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 7               | 2.63      | x     |              | 0.63         | >        | : [ | 0.1   |     | =   | 9.99  | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 5               | 0.42      | ×     |              | 0.63         | >        | Ē   | 0.1   |     | =   | 6.93  | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 2               | 8.07      | ×     |              | 0.63         | >        | ٢Ľ  | 0.1   |     | =   | 3.86  | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     |                 | 14.2      | x     |              | 0.63         | >        |     | 0.1   |     | =   | 1.95  | (75) |
| Northeast 0.9                         | 0.77         |                 | x    | 3.1       | 5               | x     | 9               | 9.21      | ×     |              | 0.63         | <b>)</b> | Ē   | 0.1   |     | =   | 1.27  | (75) |
| Southwest0.9                          | 0.77         |                 | x    | 9.4       | 5               | x     | 3               | 6.79      | ]     |              | 0.63         | _  ,     | Ē   | 0.1   |     | =   | 15.18 | (79) |
| Southwest0.9                          | 0.77         |                 | x    | 9.4       | 5               | x     | 6               | 2.67      | Ī     |              | 0.63         | _ ,      | Ē   | 0.1   |     | =   | 25.86 | (79) |
| Southwest0.9                          | 0.77         |                 | x    | 9.4       | 5               | x     | 8               | 5.75      | Ī     |              | 0.63         | _<br>    | Ē   | 0.1   |     | =   | 35.38 | (79) |
| Southwest0.9                          | 0.77         |                 | x    | 9.4       | 5               | x     | 1               | 06.25     | Ī     |              | 0.63         | _ ,      | Ē   | 0.1   |     | =   | 43.84 | (79) |
| Southwest0.9                          | 0.77         |                 | x    | 9.4       | 5               | x     | 1               | 19.01     | Ī     |              | 0.63         | _<br>_ , | Ē   | 0.1   |     | =   | 49.1  | (79) |
| Southwest0.9                          | ( 0.77       |                 | x    | 9.4       | 5               | X     | 1               | 18.15     |       |              | 0.63         | >        |     | 0.1   |     | =   | 48.75 | (79) |
| Sout <mark>hwest<sub>0.9</sub></mark> | < 0.77       |                 | x    | 9.4       | 5               | x     | 1               | 13.91     | 1     |              | 0.63         | >        | Ē   | 0.1   |     | -   | 47    | (79) |
| Sout <mark>hwest</mark> 0.9           | × 0.77       |                 | x    | 9.4       | 5               | х     | 1               | 04.39     | i /   |              | 0.63         | >        | Ē   | 0.1   |     | =   | 43.07 | (79) |
| Sout <mark>hwest</mark> 0.9           | × 0.77       |                 | x    | 9.4       | 5               | x     | 9               | 2.85      | i/    |              | 0.63         | >        | Ē   | 0.1   |     | =   | 38.31 | (79) |
| Southwest0.9                          | <b>0.77</b>  |                 | x    | 9.4       | 5               | x     | 6               | 9.27      | í –   |              | 0.63         |          | Ē   | 0.1   |     | =   | 28.58 | (79) |
| Southwest0.9                          | 0.77         |                 | x    | 9.4       | 5               | x     | 4               | 4.07      | 1     |              | 0.63         | >        | Ē   | 0.1   |     | =   | 18.18 | (79) |
| Southwest0.9                          | 0.77         |                 | x    | 9.4       | 5               | х     | 3               | 1.49      | i     |              | 0.63         | >        | Ē   | 0.1   |     | =   | 12.99 | (79) |
|                                       |              |                 |      |           |                 |       |                 |           | 4     | L            |              |          |     |       |     |     |       |      |
| Solar gains i                         | n watts, ca  | alculate        | ed   | for each  | n mont          | h     |                 |           | (83)  | m = S        | um(74)m .    | (82)     | m   |       |     |     |       |      |
| (83)m= 16.73                          | 3 29.02      | 41.07           |      | 53.18     | 61.66           |       | 62.14           | 59.53     | 53    | 8.06         | 45.24        | 32.      | 44  | 20.13 | 14. | 26  |       | (83) |
| Total gains -                         | - internal a | nd sol          | ar   | (84)m =   | : (73)n         | ) + ( | (83)m           | , watts   |       |              |              |          |     |       |     |     |       |      |
| (84)m= 391.9                          | 1 401.28     | 398.82          | 2    | 388.24    | 373.99          | ) 3   | 353.07          | 337.07    | 33    | 7.36         | 341.76       | 351      | .86 | 365.4 | 378 | .58 |       | (84) |
| 7. Mean int                           | ernal temp   | peratur         | e (  | (heating  | seaso           | n)    |                 |           |       |              |              |          |     |       |     |     |       |      |
| Temperatu                             | re during h  | eating          | pe   | eriods ir | the liv         | ving  | area            | from Tab  | ble 9 | 9, Th        | 1 (°C)       |          |     |       |     |     | 21    | (85) |
| Utilisation f                         | actor for g  | ains fo         | r li | iving are | a, h1,          | m (s  | вее Та          | ble 9a)   |       |              |              |          |     |       |     |     |       |      |
| Jan                                   | Feb          | Ма              | ·    | Apr       | Мау             | /     | Jun             | Jul       |       | Aug          | Sep          | 0        | ct  | Nov   | D   | ec  |       |      |
| (86)m= 1                              | 0.99         | 0.98            | Т    | 0.93      | 0.79            | Т     | 0.57            | 0.41      | 0     | .43          | 0.64         | 0.9      | 9   | 0.98  | 1   | I   |       | (86) |
| Mean interr                           | nal temper   | ature i         | n li | iving are | ea T1 (         | follo | ow ste          | ps 3 to 7 | 7 in  | Tabl         | e 9c)        |          |     |       |     |     | -     |      |
| (87)m= 20.77                          |              | 20.88           | -    | 20.96     | 20.99           | Т     | 21              | 21        | 1     | 21           | ,<br>21      | 20.      | 98  | 20.87 | 20. | 76  |       | (87) |
| Temperatu                             | e during h   | eating          |      | eriods in | rest c          | f dv  | vellina         | from Ta   | ahle  | αт           | և<br>հշ (°Ը) |          |     | •     |     |     | 1     |      |
| (88)m= 20.59                          |              | 20.59           | ÷    | 20.6      | 20.6            | -     | 20.61           | 20.61     | 1     | 0, 1<br>).61 | 20.61        | 20       | .6  | 20.6  | 20  | .6  |       | (88) |
|                                       |              |                 | _    |           |                 |       |                 |           | I     |              | I            |          |     | 1     |     |     | I     |      |
| Utilisation f                         |              | ains to<br>0.97 |      | 0.91      | veiiing<br>0.76 | -     | .,m (se<br>0.53 | 0.37      | T Ó   | .39          | 0.6          | 0.8      | 7   | 0.98  | 1   |     | 1     | (89) |
| Moon intorr                           |              |                 |      |           |                 | _     |                 |           | I     |              |              |          |     | 0.00  |     | •   | I     |      |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m=               | 20.28     | 20.34                   | 20.44               | 20.55                 | 20.6                   | 20.61       | 20.61          | 20.61      | 20.61          | 20.58         | 20.44           | 20.27      |          | (90)     |
|----------------------|-----------|-------------------------|---------------------|-----------------------|------------------------|-------------|----------------|------------|----------------|---------------|-----------------|------------|----------|----------|
| I                    |           |                         |                     |                       |                        |             |                |            | f              | LA = Livin    | g area ÷ (4     | 4) =       | 0.37     | (91)     |
| Moon                 | internal  | ltomnor                 | aturo (fo           | or the wh             | olo dwo                | llina) – fl | ΓΛ <b>√</b> Τ1 | ⊥ (1 _ fl  | ∧) <b>v</b> T2 |               |                 |            |          |          |
| (92)m=               | 20.46     | 20.52                   | 20.6                | 20.7                  | 20.74                  | 20.75       | 20.75          | 20.76      | 20.75          | 20.72         | 20.6            | 20.45      |          | (92)     |
|                      |           |                         |                     | n internal            | _                      |             |                |            |                |               | 20.0            | 20.10      |          | (/       |
| (93)m=               | 20.31     | 20.37                   | 20.45               | 20.55                 | 20.59                  | 20.6        | 20.6           | 20.61      | 20.6           | 20.57         | 20.45           | 20.3       |          | (93)     |
|                      |           |                         | uirement            |                       |                        | 1           |                |            |                |               |                 |            |          | . ,      |
|                      |           |                         |                     | mperatui              | re obtair              | ned at ste  | ep 11 of       | Table 9    | b, so tha      | t Ti.m=(      | 76)m an         | d re-calc  | ulate    |          |
|                      |           |                         |                     | using Ta              |                        |             | -p             |            | .,             | (             |                 |            |          |          |
|                      | Jan       | Feb                     | Mar                 | Apr                   | Мау                    | Jun         | Jul            | Aug        | Sep            | Oct           | Nov             | Dec        |          |          |
| Utilisa              | ation fac | tor for g               | ains, hm            | n:                    |                        |             |                |            |                |               |                 |            |          |          |
| (94)m=               | 0.99      | 0.99                    | 0.97                | 0.91                  | 0.76                   | 0.53        | 0.37           | 0.39       | 0.6            | 0.87          | 0.98            | 0.99       |          | (94)     |
| Usefu                | I gains,  | hmGm                    | , W = (94           | 4)m x (84             | 4)m                    | -           | -              | -          | -              |               |                 |            |          |          |
| (95)m=               | 389.07    | 396.21                  | 387.19              | 352.35                | 282.7                  | 188.42      | 125.68         | 131.42     | 205.7          | 307.23        | 357.08          | 376.52     |          | (95)     |
| Month                | nly aver  | age exte                | rnal tem            | perature              | e from Ta              | able 8      |                |            |                |               |                 |            |          |          |
| (96)m=               | 4.3       | 4.9                     | 6.5                 | 8.9                   | 11.7                   | 14.6        | 16.6           | 16.4       | 14.1           | 10.6          | 7.1             | 4.2        |          | (96)     |
| Heat                 |           | e for mea               | an interr           | al tempe              | erature,               | Lm , W =    | =[(39)m :      | x [(93)m   | – (96)m        | -             |                 |            | 1        |          |
| (97)m=               | 531.05    | 510.83                  | 458.87              | 375.28                | 285.23                 | 188.45      | 125.68         | 131.42     | 205.85         | 319.85        | 431.77          | 525.27     |          | (97)     |
| Space                |           |                         | i                   | r each n              |                        |             | 1              |            | Í              | <u> </u>      |                 |            |          |          |
| (98)m=               | 105.64    | 77.03                   | 53.33               | 16.51                 | 1.88                   | 0           | 0              | 0          | 0              | 9.38          | 53.78           | 110.67     |          |          |
|                      |           |                         |                     |                       |                        |             |                | Tota       | l per year     | (kWh/year     | ) = Sum(9       | 8)15,912 = | 428.21   | (98)     |
| Space                | e heating | g requ <mark>ire</mark> | ement in            | kWh/m²                | /year                  |             |                |            |                |               |                 |            | 5.5      | (99)     |
| 9a. En               | ergy rec  | uiremer                 | nts – Ind           | ividu <b>al h</b>     | eating s               | ystems i    | ncluding       | micro-C    | CHP)           |               |                 |            |          |          |
| Space                | e heatir  | ng:                     |                     |                       |                        |             |                |            |                |               |                 |            |          |          |
| Fra <mark>cti</mark> | on of sp  | ace hea                 | t from s            | <mark>econ</mark> dar | y/sup <mark>ple</mark> | mentary     | system         |            |                |               |                 |            | 0        | (201)    |
| Fracti               | on of sp  | ace hea                 | at from m           | nain syst             | em(s)                  |             |                | (202) = 1  | - (201) =      |               |                 |            | 1        | (202)    |
| Fracti               | on of to  | tal heati               | ng from             | main sys              | stem 1                 |             |                | (204) = (2 | 02) × [1 –     | (203)] =      |                 |            | 1        | (204)    |
| Efficie              | ency of r | nain spa                | ace heat            | ing syste             | em 1                   |             |                |            |                |               |                 |            | 89.9     | (206)    |
| Efficie              | ency of s | seconda                 | ry/suppl            | ementar               | y heatin               | g system    | ı, %           |            |                |               |                 |            | 0        | (208)    |
|                      | Jan       | Feb                     | Mar                 | Apr                   | May                    | Jun         | Jul            | Aug        | Sep            | Oct           | Nov             | Dec        | kWh/ye   | <br>var  |
| Space                |           |                         |                     | alculate              |                        |             | Jui            | Aug        | Ocp            | 001           | NOV             | Dee        | KVVII/yC | a        |
| Opuol                | 105.64    | 77.03                   | 53.33               | 16.51                 | 1.88                   | 0           | 0              | 0          | 0              | 9.38          | 53.78           | 110.67     |          |          |
| (211)m               |           |                         |                     |                       | ) <u>(</u> )           |             |                |            |                |               |                 |            |          | (211)    |
| (211)11              | 117.51    | 85.68                   | 4)] } X  <br>59.32  | 00 ÷ (20<br>18.36     | 2.09                   | 0           | 0              | 0          | 0              | 10.44         | 59.82           | 123.11     |          | (211)    |
|                      | 117.51    | 05.00                   | JJ.JZ               | 10.50                 | 2.03                   | 0           | 0              |            | l (kWh/yea     |               |                 |            | 476.32   | (211)    |
| 0                    |           | . <b>f</b> 1 / .        |                     |                       |                        |             |                | 1010       |                | (1) – Odini(1 | - ' ' / 15,1012 |            | 470.32   | (211)    |
| •                    |           |                         | econdar<br>00 ÷ (20 | y), kWh/<br>wa        | month                  |             |                |            |                |               |                 |            |          |          |
| - \[(30)<br>(215)m=  | 0         | 0                       | 00 - (20            | 0                     | 0                      | 0           | 0              | 0          | 0              | 0             | 0               | 0          |          |          |
| (210)11-             | v         | 0                       | Ű                   | Ű                     | 0                      | Ű           | Ű              |            | l (kWh/yea     | -             |                 |            | 0        | (215)    |
| Motor                | h         |                         |                     |                       |                        |             |                |            | (              | ,             | − / 15,1012     |            | U        | _(210)   |
|                      | heating   |                         | tor (calo           | ulated al             | hove                   |             |                |            |                |               |                 |            |          |          |
| Juipul               | 161.46    | 141.54                  | 146.84              | 129.12                | 124.72                 | 108.84      | 102.05         | 115.4      | 116.27         | 134.02        | 144.87          | 156.73     |          |          |
| Efficier             |           | ater hea                |                     |                       |                        |             |                | I          | I              |               |                 |            | 86.7     | (216)    |
|                      |           |                         |                     |                       |                        |             |                |            |                |               |                 |            |          | - 1° - ′ |

| (217)m= 87.94   | 87.8  | 87.53                              | 87.05     | 86.75     | 86.7  | 86.7  | 86.7      | 86.7             | 86.9   | 87.54                               | 88     | 1  | (217)   |
|---|---|------------------------------------|-----------|-----------|---|---|-----------|------------------|--|-------------------------------------|--------|--|---|
| Fuel for water  |   |                                    |           | 00.75     | 00.7  | 00.7  | 00.7      | 00.7             | 00.5   | 07.04                               | 00     |  | ()  |
| (219)m = (64)   | -   |                                    |           |           |   |   |           |                  |  | -                                   | -      | •  |   |
| (219)m= 183.6   | 161.2   | 167.76                             | 148.33    | 143.78    | 125.53  | 117.71  | 133.1     | 134.11           | 154.22   | 165.48                              | 178.11 |  | _   |
|   |   |                                    |           |           |   |   | Tota      | al = Sum(2       |  | _                                   |        | 1812.92  | (219)   |
| Annual totals<br>Space heating  |   | n d main                           | svetom    | 1         |   |   |           |                  | k  | Wh/year                             | •      | <b>kWh/yea</b><br>476.32   | n <b>r</b>  |
| Water heating   |   |                                    | System    |           |   |   |           |                  |  |                                     |        | 1812.92  | $\exists$   |
| -   |   |                                    |           |           |   |   |           |                  |  |                                     |        | 1812.92  |   |
| Electricity for p   |   |                                    |           |           |   |   |           |                  |  |                                     |        | •  |   |
| mechanical v  | rentilatio  | n - balan                          | ced, ext  | ract or p | ositive ir  | nput fron   | n outside | e                |  |                                     | 182.95 |  | (230a)  |
| central heatir  | ng pump   | :                                  |           |           |   |   |           |                  |  |                                     | 30     | ]  | (230c)  |
| boiler with a   | fan-assis   | sted flue                          |           |           |   |   |           |                  |  |                                     | 45     | ]  | (230e)  |
| Total electricit  | y for the   | above, k                           | (Wh/yea   | r         |   |   | sum       | of (230a)        | (230g) =   |                                     |        | 257.95   | (231)   |
| Electricity for I   | iahtina   |                                    |           |           |   |   |           |                  |  |                                     |        | 170.05   | (232)   |
|   | ignung  |                                    |           |           |   |   |           |                  |  |                                     |        | 476.95   | (202)   |
| 12a. CO2 em   |   | – Individi                         | ual heati | ng syste  | ems inclu   | uding mi  | cro-CHF   | þ                |  |                                     |        | 476.95   | (232)   |
|   |   | – Individi                         | ual heati | ng syste  |   |   | cro-CHF   | )                | Fmiss  | ion fac                             | tor    |  |   |
|   |   | – Individi                         | ual heati | ng syste  | En  | uding mi<br><b>ergy</b><br>/h/year                      | cro-CHF   | )                | Emiss<br>kg CO                                   | ion fac<br>2/kWh                    | tor    | Emission<br>kg CO2/ye  | s   |
|   | hissions -  |                                    |           | ng syste  | <b>En</b><br>kW                                       | ergy  | cro-CHF   |                  |  | 2/kWh                               | tor    | Emission   | s   |
| 12a. CO2 em   | nissions ·<br>I (main s   | ystem 1)                           |           | ng syste  | <b>En</b><br>kW<br>(211                               | <b>ergy</b><br>/h/year                                  | cro-CHF   |                  | kg CO  | 2/kWh                               |        | Emission<br>kg CO2/ye  | sear  |
| 12a. CO2 em<br>Space heating  | issions -<br>) (main s<br>) (second   | ystem 1)                           |           | ng syste  | <b>En</b><br>kW<br>(211                               | ergy<br>/h/year<br>I) x<br>5) x                         | cro-CHF   |                  | kg CO  | 2/kWh<br>16<br>19                   | ÷      | Emission<br>kg CO2/ye  | <b>s</b><br>ear<br>(261)  |
| 12a. CO2 em<br>Space heating<br>Space heating   | issions -<br>(main s<br>(second   | ystem 1)<br>dary)                  |           | ng syste  | En<br>kW<br>(211<br>(215                              | ergy<br>/h/year<br>I) x<br>5) x                         |           |                  | kg CO.<br>0.2<br>0.5                             | 2/kWh<br>16<br>19                   | -      | Emission<br>kg CO2/ye  | <b>s</b><br>ear<br>(261)<br>(263)                                       |
| 12a. CO2 err<br>Space heating<br>Space heating<br>Water heating   | issions (main s<br>(main s<br>(second   | ystem 1)<br>dary)<br>ng            |           |           | En<br>kW<br>(211<br>(215<br>(215)<br>(267             | ergy<br>/h/year<br>I) x<br>5) x<br>9) x                 |           |                  | kg CO.<br>0.2<br>0.5                             | 2/kWh<br>16<br>19<br>16             | -      | Emission<br>kg CO2/ye<br>102.88<br>0<br>391.59   | <b>s</b><br>ar<br>(261)<br>(263)<br>(264)                               |
| 12a. CO2 em<br>Space heating<br>Space heating<br>Water heating<br>Space and wa  | issions<br>(main s<br>(second<br>ter heati<br>oumps, f                                    | ystem 1)<br>dary)<br>ng            |           |           | En<br>kW<br>(211<br>(215<br>(215)<br>(267             | ergy<br>/h/year<br>1) x<br>5) x<br>2) x<br>1) + (262) - |           |                  | kg CO.   | 2/kWh<br>16<br>19<br>16<br>19       | -      | Emission<br>kg CO2/ye<br>102.88<br>0<br>391.59<br>494.48                               | <b>s</b><br>(261)<br>(263)<br>(264)<br>(265)                            |
| 12a. CO2 em<br>Space heating<br>Space heating<br>Water heating<br>Space and wa<br>Electricity for p                                       | issions -<br>(main s<br>(second<br>ter heati<br>oumps, f<br>ighting                       | ystem 1)<br>dary)<br>ng            |           |           | En<br>kW<br>(211<br>(215<br>(215)<br>(264)<br>t (234) | ergy<br>/h/year<br>1) x<br>5) x<br>2) x<br>1) + (262) - |           | (264) =          | kg CO.<br>0.2<br>0.5<br>0.2                      | 2/kWh<br>16<br>19<br>16<br>19<br>19 | -      | Emission<br>kg CO2/ye<br>102.88<br>0<br>391.59<br>494.48<br>133.88                     | s<br>(261)<br>(263)<br>(264)<br>(265)<br>(267)                          |
| 12a. CO2 em<br>Space heating<br>Space heating<br>Water heating<br>Space and wa<br>Electricity for p<br>Electricity for p<br>Total CO2, kg | issions -<br>(main s<br>(second<br>ter heati<br>bumps, f<br>ighting<br>/year              | ystem 1)<br>dary)<br>ng<br>ans and | electric  |           | En<br>kW<br>(211<br>(215<br>(215)<br>(264)<br>t (234) | ergy<br>/h/year<br>1) x<br>5) x<br>2) x<br>1) + (262) - |           | (264) =<br>sum c | kg CO.<br>0.2<br>0.5<br>0.2<br>0.5               | 2/kWh<br>16<br>19<br>16<br>19<br>19 | -      | Emission<br>kg CO2/ye<br>102.88<br>0<br>391.59<br>494.48<br>133.88<br>247.54<br>875.89 | S<br>(261)<br>(263)<br>(264)<br>(265)<br>(267)<br>(268)<br>(272)        |
| 12a. CO2 em<br>Space heating<br>Space heating<br>Water heating<br>Space and wa<br>Electricity for p<br>Electricity for p                  | iissions -<br>(main s<br>(second<br>ter heati<br>bumps, f<br>ighting<br>/year<br>2 Emissi | ystem 1)<br>dary)<br>ng<br>ans and | electric  |           | En<br>kW<br>(211<br>(215<br>(215)<br>(264)<br>t (234) | ergy<br>/h/year<br>1) x<br>5) x<br>2) x<br>1) + (262) - |           | (264) =<br>sum c | kg CO.<br>0.2<br>0.5<br>0.2<br>0.5<br>0.5<br>0.5 | 2/kWh<br>16<br>19<br>16<br>19<br>19 | -      | Emission<br>kg CO2/ye<br>102.88<br>0<br>391.59<br>494.48<br>133.88<br>247.54           | <b>S</b><br>(261)<br>(263)<br>(264)<br>(265)<br>(265)<br>(267)<br>(268) |

|   |                               |                     | User De        | etails:          |                |                 |                       |           |                                       |              |
|---|-------------------------------|---------------------|----------------|------------------|----------------|-----------------|-----------------------|-----------|---------------------------------------|--------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 201               |                     | ;              | Stroma<br>Softwa | re Ver         |                 |                       | Versio    | n: 1.0.4.23                           |              |
| Addross   | 1 Bed Flat, 219-223           |                     |                | Address:         |                | nh lunct        | ion I ON              |           |                                       |              |
| Address :<br>1. Overall dwelling dimer  |                               | Columati            |                | ie, Loug         | προιοαί        | JII JUIICI      | ION, LON              |           |                                       |              |
| Ground floor  |                               |                     | Area           | . ,              | (1a) x         | <b>Av. He</b> i | <b>ight(m)</b><br>2.5 | (2a) =    | <b>Volume(m<sup>3</sup>)</b><br>124.5 | (3a)         |
| Total floor area TFA = (1a  | )+(1b)+(1c)+(1d)+(1e          | e)+(1n)             | 4              | 9.8              | (4)            |                 |                       |           |                                       |              |
| Dwelling volume   |                               |                     |                |                  | (3a)+(3b)      | +(3c)+(3d       | l)+(3e)+              | .(3n) =   | 124.5                                 | (5)          |
| 2. Ventilation rate:  |                               |                     |                |                  |                |                 |                       |           |                                       |              |
| Number of chimneys  | heating                       | econdary<br>neating | ′ (<br>] + [   | other            | 1 = [          | total           | x 4                   | 40 =      | m <sup>3</sup> per hour               | _            |
| Number of open flues  |                               | 0                   | ] ' [<br>] + [ | 0                | ] - L<br>] = C | 0               |                       | 20 =      | 0                                     | (6a)<br>(6b) |
| Number of intermittent fan  | IS                            | _                   |                | -                | J L<br>T       | 0               | x 1                   | 10 =      | 0                                     | (7a)         |
| Number of passive vents   |                               |                     |                |                  | Г              | 0               | x 1                   | 10 =      | 0                                     | (7b)         |
| Number of flueless gas fire   | es                            |                     |                |                  |                | 0               | x 4                   | 40 =      | 0                                     | (7c)         |
|   |                               |                     |                |                  |                |                 |                       | Air ch    | anges <mark>per</mark> ho             | ur           |
| Infiltration due to chimney   |                               |                     |                |                  |                | 0               |                       | ÷ (5) =   | 0                                     | (8)          |
| Number of storeys in the Additional infiltration  | e dw <mark>elling</mark> (ns) |                     |                |                  |                |                 |                       | -1]x0.1 = | 0                                     | (9)<br>(10)  |
| Structural infiltration: 0.2<br>if both types of wall are pre<br>deducting areas of opening | esent, use the value corres   |                     |                |                  | •              | uction          |                       |           | 0                                     | (11)         |
| If suspended wooden flo   | oor, enter 0.2 (unsea         | led) or 0.1         | (sealed        | d), else         | enter 0        |                 |                       |           | 0                                     | (12)         |
| If no draught lobby, ente   | er 0.05, else enter 0         |                     |                |                  |                |                 |                       |           | 0                                     | (13)         |
| Percentage of windows   | and doors draught s           | tripped             |                |                  |                |                 |                       |           | 0                                     | (14)         |
| Window infiltration   |                               |                     |                | 0.25 - [0.2      |                |                 | (45)                  |           | 0                                     | (15)         |
| Infiltration rate<br>Air permeability value, c  | 750 overessed in out          | nic motros          |                | (8) + (10) ·     |                |                 |                       | aroa      | 0                                     | (16)         |
| If based on air permeabilit   |                               |                     | •              | •                | •              |                 | invelope              | alea      | 0.1                                   | (17)<br>(18) |
| Air permeability value applies  | -                             |                     |                |                  |                | is being us     | sed                   | l         | 0.1                                   |              |
| Number of sides sheltered   | Ł                             |                     |                |                  |                |                 |                       |           | 3                                     | (19)         |
| Shelter factor  |                               |                     | (              | (20) = 1 - [     | 0.075 x (1     | 9)] =           |                       |           | 0.78                                  | (20)         |
| Infiltration rate incorporation   | ng shelter factor             |                     | (              | (21) = (18)      | x (20) =       |                 |                       |           | 0.08                                  | (21)         |
| Infiltration rate modified fo   | <u> </u>                      | t t                 |                |                  |                |                 | i                     | ·         |                                       |              |
| Jan Feb I   | Mar Apr May                   | Jun                 | Jul            | Aug              | Sep            | Oct             | Nov                   | Dec       |                                       |              |
| Monthly average wind spe  | - I I                         |                     |                |                  |                |                 |                       | ·         |                                       |              |
| (22)m= 5.1 5 4  | 4.9 4.4 4.3                   | 3.8                 | 3.8            | 3.7              | 4              | 4.3             | 4.5                   | 4.7       |                                       |              |
| Wind Factor (22a)m = (22  | )m ÷ 4                        |                     |                |                  |                |                 |                       |           |                                       |              |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08                  | 0.95                | 0.95           | 0.92             | 1              | 1.08            | 1.12                  | 1.18      |                                       |              |

| Adjuste                          | ed infiltra           | ation rat  | e (allowi  | ng for sh               | elter an    | d wind s    | peed) =    | (21a) x      | (22a)m      |                       | _                |           |                |                |
|----------------------------------|-----------------------|------------|------------|-------------------------|-------------|-------------|------------|--------------|-------------|-----------------------|------------------|-----------|----------------|----------------|
|                                  | 0.1                   | 0.1        | 0.09       | 0.09                    | 0.08        | 0.07        | 0.07       | 0.07         | 0.08        | 0.08                  | 0.09             | 0.09      |                |                |
|                                  | ate effec<br>echanica |            | -          | rate for t              | he appli    | cable ca    | se         |              |             |                       |                  |           | 0.5            | (220)          |
|                                  |                       |            |            | endix N, (2             | 3b) = (23a  | a) x Fmv (e | equation ( | N5)) . other | wise (23b   | ) = (23a)             |                  |           | 0.5            | (23a)<br>(23b) |
|                                  |                       |            |            | iency in %              |             |             |            |              |             | ) (200)               |                  |           | 0.5            |                |
|                                  |                       |            | -          | -                       | -           |             |            |              |             | 2b)m i (              | 22h) v [         | 1 – (23c) | 73.1           | (23c)          |
| (24a)m=                          |                       | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21 (24a    | 0.21        | 0.22                  | 230) × [<br>0.22 | 0.23      | - 100j         | (24a)          |
|                                  |                       |            |            |                         |             |             |            |              |             |                       |                  | 0.20      | l              | (,)            |
| D) II<br>(24b)m=                 |                       |            |            | entilation              |             |             |            | 0 (240       | 0 m = (22)  | $\frac{2}{0}$ m + (1) | 230)             | 0         | 1              | (24b)          |
|                                  |                       | -          |            | •                       | -           | -           | -          | -            | •           | 0                     | 0                | 0         |                | (240)          |
| ,                                |                       |            |            | ntilation c<br>hen (24c | •           | •           |            |              |             | .5 × (23t             | <b>)</b> )       |           |                |                |
| (24c)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0                     | 0                | 0         |                | (24c)          |
|                                  |                       |            |            | ole hous                |             |             |            |              |             |                       |                  |           | 1              |                |
| i                                | if (22b)m             | n = 1, the | en (24d)   | m = (22k                | o)m othe    | erwise (2   | 4d)m =     | 0.5 + [(2    | 2b)m² x     | 0.5]                  |                  |           | 1              |                |
| (24d)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0                     | 0                | 0         |                | (24d)          |
| Effe                             | ctive air             | change     | rate - er  | nter (24a               | ) or (24b   | o) or (24   | c) or (24  | d) in box    | (25)        |                       |                  |           |                |                |
| (25)m=                           | 0.23                  | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21         | 0.21        | 0.22                  | 0.22             | 0.23      |                | (25)           |
| 3. He                            | at losses             | s and he   | eat loss i | oaramete                | er:         |             |            |              |             |                       |                  |           |                | _              |
| ELEN                             |                       | Gros       |            | Openin                  |             | Net Ar      | ea         | U-valu       | Je          | AXU                   |                  | k-value   | e              | AXk            |
|                                  |                       | area       |            | 'n                      |             | A ,n        | n²         | W/m2         | K           | (VV/                  | K)               | kJ/m²·l   | ĸ              | kJ/K           |
| Windo                            | ws Type               | 1          |            |                         |             | 10.8        | x1/        | [1/( 0.73 )+ | - 0.04] =   | 7.66                  |                  |           |                | (27)           |
| Windo                            | <mark>ws</mark> Type  | 2          |            |                         |             | 2.475       | ; x1/      | [1/( 0.73 )+ | - 0.04] =   | 1.76                  |                  |           |                | (27)           |
| Wall <mark>s</mark> <sup>-</sup> | Type1                 | 19.        | 5          | 10.8                    |             | 8.7         | x          | 0.15         | ] = [       | 1.31                  |                  |           |                | (29)           |
| Walls <sup>-</sup>               | Гуре2                 | 3.5        |            | 2.47                    |             | 1.03        | ×          | 0.15         | <br>  =     | 0.15                  | F i              |           | <b>i i</b>     | (29)           |
| Total a                          | rea of el             | lements    | , m²       |                         |             | 23          |            |              |             |                       |                  |           |                | (31)           |
| Party v                          | vall                  |            |            |                         |             | 51.75       | j x        | 0            |             | 0                     |                  |           |                | (32)           |
| Party f                          | _                     |            |            |                         |             | 49.8        | $\exists$  |              | เ           |                       | L                |           | $\dashv$       | (32a)          |
| Party c                          | eiling                |            |            |                         |             | 49.8        |            |              |             |                       | ĺ                |           | $\exists$      | (32b)          |
| Interna                          | al wall **            |            |            |                         |             | 45.6        |            |              |             |                       | [                |           | $\exists \Box$ | (32c)          |
|                                  |                       |            |            |                         |             |             | ated using | ı formula 1, | /[(1/U-valu | ıe)+0.04] a           | as given in      | paragraph | 3.2            |                |
|                                  | heat los              |            |            | nternal wall            | s and pan   | litions     |            | (26)(30)     | + (32) =    |                       |                  |           | 40.07          | (22)           |
|                                  | apacity (             |            |            | 0)                      |             |             |            | (20)(00)     |             | (30) + (32            | 2) + (225)       | (220) -   | 10.87          |                |
|                                  |                       |            | . ,        | - Cm ·                  |             | k l/m2k     |            |              |             | tive Value            | · · · ·          | (326) =   | 13269.5        |                |
|                                  |                       | -          |            | P = Cm ÷                | ,           |             |            | racisaly the |             |                       |                  | abla 1f   | 250            | (35)           |
|                                  | used instea           |            |            |                         | constructi  | ion ale not | KIIOWII PI | ecisely life | inucative   | values of             |                  |           |                |                |
| Therm                            | al bridge             | es : S (L  | x Y) cal   | culated u               | using Ap    | pendix ł    | <          |              |             |                       |                  |           | 5.22           | (36)           |
|                                  |                       |            | are not kn | own (36) =              | = 0.05 x (3 | 1)          |            |              |             |                       |                  |           |                |                |
| Total fa                         | abric hea             | at loss    |            |                         |             |             |            |              | (33) +      | (36) =                |                  |           | 16.09          | (37)           |
| Ventila                          | tion hea              | t loss ca  | alculated  | monthly                 | /           |             |            |              | (38)m       | = 0.33 × (            | 25)m x (5        | )         | 1              |                |
|                                  | Jan                   | Feb        | Mar        | Apr                     | May         | Jun         | Jul        | Aug          | Sep         | Oct                   | Nov              | Dec       |                |                |
| (38)m=                           | 9.59                  | 9.51       | 9.43       | 9.03                    | 8.95        | 8.55        | 8.55       | 8.47         | 8.71        | 8.95                  | 9.11             | 9.27      |                | (38)           |
| Heat tr                          | ansfer c              | oefficier  | nt, W/K    |                         |             |             |            |              | (39)m       | = (37) + (            | 38)m             |           |                |                |
| (39)m=                           | 25.68                 | 25.6       | 25.52      | 25.12                   | 25.04       | 24.64       | 24.64      | 24.56        | 24.8        | 25.04                 | 25.2             | 25.36     |                |                |
| Stroma I                         | FSAP 2012             | 2 Version: | 1.0.4.23   | (SAP 9.92)              | - http://ww | ww.stroma   | .com       |              | 1           | Average =             | Sum(39)1         | 12 /12=   | 25.1p          | age 2 of 39)   |

| Heat lo                | ss para               | ımeter (H                       | HLP), W     | /m²K                 |                |            |             |                        | (40)m                     | = (39)m ÷                  | - (4)                  |          |         |      |
|------------------------|-----------------------|---------------------------------|-------------|----------------------|----------------|------------|-------------|------------------------|---------------------------|----------------------------|------------------------|----------|---------|------|
| (40)m=                 | 0.52                  | 0.51                            | 0.51        | 0.5                  | 0.5            | 0.49       | 0.49        | 0.49                   | 0.5                       | 0.5                        | 0.51                   | 0.51     |         |      |
|                        |                       |                                 |             |                      |                | !          |             | 1                      | ,                         | Average =                  | Sum(40)1.              | .12 /12= | 0.5     | (40) |
| Numbe                  | -                     | /s in mo                        | <u> </u>    | r í                  |                | <u> </u>   | I           | <u> </u>               |                           |                            |                        | _        |         |      |
|                        | Jan                   | Feb                             | Mar         | Apr                  | May            | Jun        | Jul         | Aug                    | Sep                       | Oct                        | Nov                    | Dec      |         |      |
| (41)m=                 | 31                    | 28                              | 31          | 30                   | 31             | 30         | 31          | 31                     | 30                        | 31                         | 30                     | 31       |         | (41) |
|                        |                       |                                 |             |                      |                |            |             |                        |                           |                            |                        |          |         |      |
| 4. Wa                  | ter heat              | ting ene                        | rgy requ    | irement:             |                |            |             |                        |                           |                            |                        | kWh/ye   | ear:    |      |
| if TF.                 | A > 13.9              | upancy,<br>9, N = 1<br>9, N = 1 |             | (1 - exp             | (-0.0003       | 349 x (TF  | FA -13.9    | )2)] + 0.(             | 0013 x ( <sup>-</sup>     | TFA -13                    |                        | 68       |         | (42) |
| Reduce                 | the annua             | al average                      | hot water   | usage by             | 5% if the c    |            | designed    | (25 x N)<br>to achieve |                           | se target o                |                        | 1.2      |         | (43) |
|                        | Jan                   | Feb                             | Mar         | Apr                  | May            | Jun        | Jul         | Aug                    | Sep                       | Oct                        | Nov                    | Dec      |         |      |
| Hot wate               | r usage i             | n litres per                    | r day for e |                      | ,              | ctor from  | Table 1c x  | -                      |                           |                            |                        |          |         |      |
| (44)m=                 | 81.62                 | 78.65                           | 75.68       | 72.72                | 69.75          | 66.78      | 66.78       | 69.75                  | 72.72                     | 75.68                      | 78.65                  | 81.62    |         |      |
|                        |                       |                                 |             | I                    |                | I          |             | I                      | -                         | rotal = Su                 | m(44) <sub>112</sub> = |          | 890.4   | (44) |
| Ener <mark>gy</mark> c | content of            | hot water                       | used - ca   | lculated m           | onthly $= 4$ . | 190 x Vd,r | m x nm x L  | OTm / 3600             | ) kWh/mor                 | oth ( <mark>see T</mark> a | ables 1b, 1            | c, 1d)   |         |      |
| (45)m=                 | 1 <mark>2</mark> 1.04 | 105.86                          | 109.24      | 95. <mark>2</mark> 4 | 91.38          | 78.86      | 73.07       | 83.85                  | 84.85                     | 98.89                      | 107.94                 | 117.22   |         |      |
| If instant             | aneous w              | vətor hoati                     | ng at poin  | t of use (no         | hot water      | r storage) | enter () in | boxes (46              |                           | Total = Su                 | m(45) <sub>112</sub> = | :        | 1167.46 | (45) |
|                        |                       |                                 |             |                      |                |            |             |                        |                           |                            |                        |          |         | (10) |
| (46)m=<br>Water s      | 18.16                 | 15.88                           | 16.39       | 14.29                | 13.71          | 11.83      | 10.96       | 12.58                  | 12.73                     | 14.83                      | 16.19                  | 17.58    |         | (46) |
|                        | -                     |                                 | includir    | ng any se            | olar or M      | WHRS       | storage     | within sa              | ame ves                   | sel                        |                        | )        |         | (47) |
|                        |                       |                                 |             | -                    |                | enter 110  |             |                        |                           |                            | · · · · ·              | 5        |         | ()   |
|                        | •                     | -                               |             |                      | -              |            |             | ombi boil              | ers) ente                 | er '0' in (                | 47)                    |          |         |      |
| Water s                | storage               | loss:                           |             | ,                    |                |            |             |                        |                           | ·                          | ,                      |          |         |      |
| a) If m                | anufact               | urer's d                        | eclared I   | oss facto            | or is kno      | wn (kWł    | n/day):     |                        |                           |                            | (                      | 0        |         | (48) |
| Tempe                  | rature f              | actor fro                       | m Table     | 2b                   |                |            |             |                        |                           |                            | (                      | C        |         | (49) |
| Energy                 | lost fro              | m watei                         | · storage   | e, kWh/ye            | ear            |            |             | (48) x (49)            | ) =                       |                            | (                      | )        |         | (50) |
|                        |                       |                                 |             | •                    |                | or is not  |             |                        |                           |                            |                        |          |         |      |
|                        |                       | -                               |             |                      | le 2 (kW       | h/litre/da | ay)         |                        |                           |                            | (                      | 0        |         | (51) |
|                        | -                     | eating s<br>from Ta             |             | 011 4.3              |                |            |             |                        |                           |                            |                        | 2        | l       | (52) |
|                        |                       | actor fro                       |             | 2b                   |                |            |             |                        |                           |                            |                        | )<br>)   |         | (52) |
|                        |                       |                                 |             | e, kWh/ye            | aar            |            |             | (47) x (51)            | ) x (52) x ( <sup>4</sup> | 53) -                      |                        |          |         | (54) |
| •••                    |                       | (54) in (5                      | -           | , KVVII/y            | 501            |            |             | (47) X (01)            | )                         | 00) -                      |                        | )<br>)   |         | (54) |
|                        | . ,                   | . , .                           | ,           | for each             | month          |            |             | ((56)m = (             | 55) × (41)ı               | m                          | `                      | 5        |         | ()   |
| (56)m=                 | 0                     | 0                               | 0           | 0                    | 0              | 0          | 0           | 0                      | 0                         | 0                          | 0                      | 0        |         | (56) |
|                        | r contains            | s dedicate                      | d solar sto | prage, (57)          | -              |            |             | -                      | 7)m = (56)                | -                          | H11) is fro            | -        | ix H    |      |
| (57)m=                 | 0                     | 0                               | 0           | 0                    | 0              | 0          | 0           | 0                      | 0                         | 0                          | 0                      | 0        |         | (57) |
| Priman                 |                       | loss (ar                        | nual) fr    | ,<br>om Table        | <u>.</u> 3     | -          | •           | -                      | •                         |                            |                        | )        |         | (58) |
| -                      |                       |                                 |             |                      |                | (59)m = (  | (58) ÷ 36   | 65 × (41)              | m                         |                            | Ľ`                     | -        | I       |      |
| -                      |                       |                                 |             |                      |                | . ,        | . ,         | ng and a               |                           | r thermo                   | stat)                  |          |         |      |
| (59)m=                 | 0                     | 0                               | 0           | 0                    | 0              | 0          | 0           | 0                      | 0                         | 0                          | 0                      | 0        |         | (59) |
| L                      |                       |                                 |             |                      |                |            |             |                        |                           |                            |                        |          | I       |      |

| Combi   | loss ca               | alculated                | for eac   | h month     | (61)m =     | (60   | )) ÷ 36 | 65 × (41)                | )m           |              |                     |               |             |                      |      |
|---------|-----------------------|--------------------------|-----------|-------------|-------------|-------|---------|--------------------------|--------------|--------------|---------------------|---------------|-------------|----------------------|------|
| (61)m=  | 11.76                 | 10.62                    | 11.74     | 11.35       | 11.71       | 1     | 1.32    | 11.69                    | 11.7         | 11.33        | 11.73               | 11.37         | 11.76       | ]                    | (61) |
| Total h | neat rec              | uired for                | water h   | neating     | calculated  | d fo  | r eacl  | n month                  | (62)m =      | 0.85 ×       | (45)m ·             | + (46)m +     | (57)m +     | -<br>· (59)m + (61)m |      |
| (62)m=  | 132.8                 | 116.48                   | 120.98    | 106.58      | 103.1       | 9     | 0.18    | 84.76                    | 95.56        | 96.19        | 110.62              | 2 119.31      | 128.98      |                      | (62) |
| Solar D | -IW input             | calculated               | using Ap  | pendix G    | or Appendix | κΗ (  | (negati | ve quantity              | /) (enter '0 | ' if no sola | ar contrib          | ution to wate | er heating) |                      |      |
| (add a  | ddition               | al lines if              | FGHR      | S and/or    | WWHRS       | S ap  | plies   | , see Ap                 | pendix (     | G)           |                     |               |             | -                    |      |
| (63)m=  | 0                     | 0                        | 0         | 0           | 0           |       | 0       | 0                        | 0            | 0            | 0                   | 0             | 0           |                      | (63) |
| Outpu   | t from v              | vater hea                | ter       |             |             |       |         |                          | -            | -            |                     |               | _           | _                    |      |
| (64)m=  | 132.8                 | 116.48                   | 120.98    | 106.58      | 103.1       | 9     | 0.18    | 84.76                    | 95.56        | 96.19        | 110.62              | 2 119.31      | 128.98      |                      | _    |
|         |                       |                          |           |             |             |       |         |                          | Outp         | out from w   | ater hea            | ter (annual)  | 112         | 1305.54              | (64) |
| Heat g  | ains fro              | om water                 | heating   | g, kWh/r    | nonth 0.2   | 5 ′   | [0.85   | × (45)m                  | + (61)m      | n] + 0.8 x   | x [(46)r            | n + (57)m     | + (59)m     | []                   |      |
| (65)m=  | 43.19                 | 37.85                    | 39.26     | 34.5        | 33.31       | 2     | 9.05    | 27.22                    | 30.81        | 31.05        | 35.81               | 38.73         | 41.92       |                      | (65) |
| inclu   | ıde (57               | )m in calo               | culation  | of (65)r    | n only if c | cylir | nder i  | s in the c               | dwelling     | or hot w     | ater is             | from com      | munity h    | neating              |      |
| 5. In   | ternal g              | ains (see                | e Table   | 5 and 5     | a):         |       |         |                          |              |              |                     |               |             |                      |      |
| Metab   | olic gai              | ns (Table                | e 5), Wa  | atts        |             |       |         |                          |              |              |                     |               |             |                      |      |
|         | Jan                   | Feb                      | Mar       | Apr         | May         |       | Jun     | Jul                      | Aug          | Sep          | Oct                 | Nov           | Dec         |                      |      |
| (66)m=  | 84.21                 | 84.21                    | 84.21     | 84.21       | 84.21       | 8     | 84.21   | 84.21                    | 84.21        | 84.21        | 8 <mark>4.21</mark> | 84.21         | 84.21       |                      | (66) |
| Lightir | g gains               | s (calcula               | ted in A  | ppendix     | . L, equat  | tion  | L9 o    | r L9a), a                | lso see      | Table 5      |                     |               |             |                      |      |
| (67)m=  | 17.77                 | 15.79                    | 12.84     | 9.72        | 7.27        | (     | 5.13    | 6.63                     | 8.62         | 11.56        | 14.68               | 17.14         | 18.27       |                      | (67) |
| Applia  | nces ga               | ains (ca <mark>lc</mark> | ulated i  | n Appei     | ndix L, eq  | uat   | tion L  | 13 o <mark>r L1</mark> : | 3a), also    | see Ta       | ble 5               |               |             |                      |      |
| (68)m=  | 146.71                | 148.24                   | 144.4     | 136.23      | 125.92      | 1     | 16.23   | 109.76                   | 108.24       | 112.07       | 120.24              | 4 130.55      | 140.24      |                      | (68) |
| Cookir  | ng gain               | s (calcula               | ated in A | Appendi     | x L, equa   | tior  | n L15   | or L15a)                 | ), also se   | ee Table     | e 5                 |               |             |                      |      |
| (69)m=  | 31.42                 | 31.42                    | 31.42     | 31.42       | 31.42       | 3     | 1.42    | 31.42                    | 31.42        | 31.42        | 31.42               | 31.42         | 31.42       | 1                    | (69) |
| Pumps   | s and fa              | ans gains                | (Table    | 5a)         |             |       |         |                          |              |              |                     |               |             |                      |      |
| (70)m=  | 3                     | 3                        | 3         | 3           | 3           |       | 3       | 3                        | 3            | 3            | 3                   | 3             | 3           | ]                    | (70) |
| Losse   | s e.g. e              | vaporatio                | n (nega   | ative val   | ues) (Tab   | ble   | 5)      |                          |              | •            | •                   | •             |             |                      |      |
| (71)m=  | -67.37                | -67.37                   | -67.37    | -67.37      | -67.37      | -6    | 67.37   | -67.37                   | -67.37       | -67.37       | -67.37              | -67.37        | -67.37      | ]                    | (71) |
| Water   | heating               | ,<br>g gains (1          | Table 5)  |             | •           |       |         |                          |              |              | •                   | •             | <u>.</u>    |                      |      |
| (72)m=  | 58.05                 | 56.33                    | 52.77     | 47.92       | 44.78       | 4     | 0.35    | 36.58                    | 41.41        | 43.12        | 48.14               | 53.8          | 56.34       | ]                    | (72) |
| Total   | interna               | l gains =                | :         |             | -           |       | (66)    | m + (67)m                | n + (68)m -  | + (69)m +    | (70)m +             | (71)m + (72)  | )m          | 1                    |      |
| (73)m=  | 273.8                 | 271.62                   | 261.27    | 245.14      | 229.23      | 2     | 13.98   | 204.24                   | 209.52       | 218.02       | 234.3               | 2 252.75      | 266.11      | ]                    | (73) |
| 6. So   | lar gair              | is:                      | <u>.</u>  |             |             |       |         |                          |              |              |                     |               | <u>.</u>    |                      |      |
| Solar ( | gains are             | calculated               | using sol | ar flux fro | n Table 6a  | and   | associ  | ated equa                | tions to co  | onvert to th | ne applic           | able orienta  | tion.       |                      |      |
| Orient  |                       | Access F                 |           | Are         |             |       | Flu     |                          | _            | g_           |                     | FF            |             | Gains                |      |
|         |                       | Table 6d                 |           | m²          |             |       | Tat     | ole 6a                   | Τ            | able 6b      |                     | Table 6c      |             | (W)                  |      |
| Southe  | ast <mark>0.9x</mark> | 0.77                     | )         | ( 2         | .47         | x     | 3       | 6.79                     | x            | 0.63         | x                   | 0.1           | =           | 3.98                 | (77) |
|         | ast <mark>0.9x</mark> | 0.77                     | )         | < _ 2       | .47         | x     | 6       | 2.67                     | x            | 0.63         | x                   | 0.1           | =           | 6.77                 | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77                     | )         | < 2         | .47         | x     | 8       | 5.75                     | x            | 0.63         | x                   | 0.1           | =           | 9.27                 | (77) |
|         | ast <mark>0.9x</mark> | 0.77                     | )         | ( 2         | .47         | x     | 1       | 06.25                    | x            | 0.63         | x                   | 0.1           | =           | 11.48                | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77                     | )         | ( 2         | .47         | x     | 1       | 19.01                    | x            | 0.63         | x                   | 0.1           | =           | 12.86                | (77) |

| Southeast 0  | .9x 0.77   | x  | 2.47  | 3  | ۲ 1   | 18.15  | x                          | 0.63   | x                      | 0.1    | =             | = 12.77  | (77)         |
|--|--|--|---|--|---|--|----------------------------|--|------------------------|--------|---------------|----------|--------------|
| Southeast 0  | . <mark>9x</mark> 0.77   | x  | 2.47  | ;  | ( 1   | 13.91  | x                          | 0.63   | ×                      | 0.1    | -             | = 12.31  | (77)         |
| Southeast 0  | .9x 0.77   | x  | 2.47  | ;  | ۲ (   | 04.39  | x                          | 0.63   | ×                      | 0.1    | -             | = 11.28  | (77)         |
| Southeast 0  | .9x 0.77   | x  | 2.47  | ;  | <u>د</u> ا                                    | 92.85  | x                          | 0.63   | x                      | 0.1    | -             | = 10.03  | (77)         |
| Southeast 0  | .9x 0.77   | x  | 2.47  | 3  | (   | 69.27  | x                          | 0.63   | x                      | 0.1    | =             | = 7.48   | (77)         |
| Southeast 0  | .9x 0.77   | x  | 2.47  | 3  | ( ,   | 44.07  | x                          | 0.63   | ×                      | 0.1    |               | = 4.76   | (77)         |
| Southeast 0  | .9x 0.77   | x  | 2.47  | 3  | ( ;   | 31.49  | x                          | 0.63   | <b>x</b>               | 0.1    |               | = 3.4    | (77)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ( ;   | 36.79  | 1                          | 0.63   | _ x [                  | 0.1    | -             | = 17.35  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ( (   | 62.67  | 1                          | 0.63   | _ × [                  | 0.1    | <b>-</b>      | = 29.55  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  |  | ( ;   | 85.75  | 1                          | 0.63   |                        | 0.1    | <u> </u>      | = 40.43  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ·   | 06.25  | 1                          | 0.63   |                        | 0.1    |               | = 50.1   | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ( 1   | 19.01  | i i                        | 0.63   |                        | 0.1    | -             | = 56.12  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ( <b>1</b>                                    | 18.15  | i i                        | 0.63   |                        | 0.1    | <b>-</b>      | = 55.71  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ( <u> </u>                                    | 13.91  | 1                          | 0.63   |                        | 0.1    | -             | = 53.71  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ( <u> </u>                                    | 04.39  |                            | 0.63   |                        | 0.1    | <b>-</b>      | = 49.22  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | <u>ا</u>                                      | 92.85  | 1                          | 0.63   |                        | 0.1    | -             | = 43.78  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77   | x  | 10.8  | ;  | ( (   | 69.27  | 1                          | 0.63   |                        | 0.1    | =             | = 32.66  | (79)         |
| Sout <mark>hwest</mark> 0  | .9x 0.77   | x  | 10.8  |  |   | 44.07  |                            | 0.63   | x                      | 0.1    | -             | = 20.78  | (79)         |
| Sout <mark>hwest</mark> 0  | .9x 0.77   | ×  | 10.8  | Ξ,   |   | 31.49  | 1                          | 0.63   | X                      | 0.1    | =             | = 14.85  | (79)         |
|  |  |  |   |  |   |  |                            |  | L                      |        |               |          |              |
| Solar gain   | s in watts, cal  | culated  | for each r  | nonth  |   |  | (83)m                      | = Sum(74)m .   | (82)m                  |        |               |          |              |
|  | .32 36.32  | 49.7   |   | 68.98  | 68.48   | 66.02  | 60.                        |  | 40.15                  | 25.54  | 18.25         | 5        | (83)         |
| Total gains  | s – internal an  | d solar  | (84)m = (7  | 73)m +   | (83)m   | , watts  | <u> </u>                   |  |                        |        | I             | _        |              |
| (84)m= 295   | 5.12 307.94  | 310.97   | 306.72 2  | 298.2  | 282.45  | 270.25   | 270                        | .02 271.84   | 274.47                 | 278.29 | 284.3         | 6        | (84)         |
| 7 Mean i   | nternal tempe  | erature  | (heating se   | eason)   |   |  |                            |  |                        |        | •             | _        |              |
|  | ure during he  |  |   | , i i i i i i i i i i i i i i i i i i i        | a area  | from Tab   | ole 9.                     | Th1 (°C)   |                        |        |               | 21       | (85)         |
|  | factor for gai   | • •  |   |  | -   |  | ,                          | ( -)   |                        |        |               |          | `            |
|  | an Feb   | Mar  | Apr   | May  | Jun   | Jul  | A                          | ug Sep   | Oct                    | Nov    | Dec           | 2        |              |
|  | 99 0.99  | 0.97   |   | 0.77   | 0.56  | 0.4  | 0.4                        | • ·  | 0.88                   | 0.98   | 0.99          | -        | (86)         |
| Mean inte  | ernal temperat   | ture in l  | iving area  | I  | low etc                                       | $\frac{1}{2}$                                    | I<br>7 in T                |  |                        |        | <b></b>       |          |              |
| (87)m= 20  | ·  | 20.85  |   | 20.99  | 21  | 21   | 2                          |  | 20.96                  | 20.83  | 20.69         | )        | (87)         |
|  |  |  |   |  |   | I  |                            |  | 20.00                  |        |               |          |              |
| Iamnoro  |  |  |   |  |   |  |                            |  |                        |        |               |          |              |
| ·  | Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)         88)m=       20.51       20.51       20.52       20.53       20.53       20.52       20.52       20.51       (88) |  |   |  |   |  |                            |  |                        |        |               |          |              |
| · · · · · · · · · · · · · · · · · · ·  | <u> </u>   | ating p<br>20.51                                 |   | 20.52  | 20.53   | 20.53  | 20.                        |  | 20.52                  | 20.52  | 20.51         |          | (88)         |
| (88)m= 20<br>Utilisation   | .51 20.51  | 20.51  | 20.52 2<br>est of dwe   | 20.52<br>Illing, h                             | 20.53<br>2,m (s                               | 20.53  | 20.                        | 53 20.52   | 20.52                  | _I     | I             |          |              |
| (88)m= 20<br>Utilisation   | .51 20.51  | 20.51  | 20.52 2<br>est of dwe   | 20.52  | 20.53   | 20.53  | 20.                        | 53 20.52   | 20.52<br>0.86          | 0.97   | 20.51<br>0.99 |          | (88)<br>(89) |
| (88)m= 20<br>Utilisation<br>(89)m= 0.  | .51 20.51  | 20.51<br>ins for r<br>0.96                       | 20.52 2<br>est of dwe<br>0.89   | 20.52<br>Illing, h<br>0.73                     | 20.53<br>2,m (so<br>0.52                      | 20.53<br>ee Table<br>0.36                        | 20.9<br>9a)<br>0.3         | 53     20.52       8     0.58  | 0.86                   | _I     | I             |          |              |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte                           | 51 20.51<br>1 factor for gai   | 20.51<br>ins for r<br>0.96                       | 20.52 2<br>est of dwe<br>0.89 he rest of                                | 20.52<br>Illing, h<br>0.73                     | 20.53<br>2,m (so<br>0.52                      | 20.53<br>ee Table<br>0.36                        | 20.9<br>9a)<br>0.3         | 53         20.52           8         0.58           to 7 in Tabl   | 0.86                   | _I     | I             |          |              |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte                           | 51 20.51<br>6 factor for gai<br>99 0.98<br>ernal temperat  | 20.51<br>ins for r<br>0.96<br>ture in t          | 20.52 2<br>est of dwe<br>0.89 he rest of                                | 20.52<br>Iling, h<br>0.73<br>dwellir           | 20.53<br>2,m (so<br>0.52<br>ng T2 (f          | 20.53<br>ee Table<br>0.36<br>follow ste          | 20.9<br>9a)<br>0.3         | 3         20.52           8         0.58           to 7 in Tabl           53         20.52                                     | 0.86<br>e 9c)<br>20.48 | 0.97   | 0.99          | 0.47     | (89)         |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte<br>(90)m= 20              | 51         20.51           a factor for gai           99         0.98           ernal temperation           12         20.2  | 20.51<br>ins for r<br>0.96<br>ture in t<br>20.32 | 20.52     2       est of dwe       0.89                                 | 20.52<br>Illing, h<br>0.73<br>dwellir<br>20.51 | 20.53<br>2,m (so<br>0.52<br>ng T2 (f<br>20.53 | 20.53<br>ee Table<br>0.36<br>follow ste<br>20.53 | 20.9<br>9a)<br>0.3<br>20.9 | 8         0.58           to 7 in Tabl           53         20.52   | 0.86<br>e 9c)<br>20.48 | 0.97   | 0.99          | <br><br> | (89)         |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte<br>(90)m= 20<br>Mean inte | 51 20.51<br>6 factor for gai<br>99 0.98<br>ernal temperat  | 20.51<br>ins for r<br>0.96<br>ture in t<br>20.32 | 20.52 2<br>est of dwe<br>0.89 4<br>he rest of<br>20.45 2<br>r the whole | 20.52<br>Illing, h<br>0.73<br>dwellir<br>20.51 | 20.53<br>2,m (so<br>0.52<br>ng T2 (f<br>20.53 | 20.53<br>ee Table<br>0.36<br>follow ste<br>20.53 | 20.9<br>9a)<br>0.3<br>20.9 | <ul> <li>20.52</li> <li>20.52</li> <li>8 0.58</li> <li>to 7 in Tabl</li> <li>53 20.52</li> <li>f</li> <li>fLA) × T2</li> </ul> | 0.86<br>e 9c)<br>20.48 | 0.97   | 0.99          | 0.47     | (89)         |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= 20.2                     |                              | 20.42      | 20.53              | 20.58     | 20.6       | 20.6     | 20.6        | 20.6         | 20.56                 | 20.4                            | 20.23      |                           | (93)  |
|---------------------------------|------------------------------|------------|--------------------|-----------|------------|----------|-------------|--------------|-----------------------|---------------------------------|------------|---------------------------|-------|
|                                 | neating req                  |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
|                                 | ne mean int<br>ion factor fo |            | •                  |           | ied at ste | ep 11 of | Table 9t    | o, so tha    | t Ti,m=(              | 76)m an                         | d re-calc  | culate                    |       |
| Ja                              |                              | Mar        | Apr                | May       | Jun        | Jul      | Aug         | Sep          | Oct                   | Nov                             | Dec        |                           |       |
|                                 | factor for g                 |            |                    | may       | ••••       | • •      |             | 000          | •••                   |                                 | 200        |                           |       |
| (94)m= 0.9                      |                              | 0.96       | 0.89               | 0.74      | 0.52       | 0.36     | 0.38        | 0.59         | 0.86                  | 0.97                            | 0.99       |                           | (94)  |
| Useful gai                      | ns, hmGm                     | , W = (94  | 4)m x (84          | 4)m       |            |          |             |              |                       |                                 |            |                           |       |
| (95)m= 291.                     | 89 301.9                     | 297.73     | 272.04             | 219.52    | 147.69     | 98.5     | 103.12      | 160.78       | 236.3                 | 270.11                          | 281.99     |                           | (95)  |
| Monthly av                      | verage exte                  | ernal tem  | perature           | from Ta   | able 8     |          |             |              |                       |                                 |            |                           |       |
| (96)m= 4.3                      |                              | 6.5        | 8.9                | 11.7      | 14.6       | 16.6     | 16.4        | 14.1         | 10.6                  | 7.1                             | 4.2        |                           | (96)  |
|                                 | rate for me                  | 1          | · · ·              |           | i          | - ,      |             |              | -                     |                                 |            | I                         |       |
| (97)m= 409.                     |                              | 355.23     | 292.22             | 222.47    | 147.78     | 98.51    | 103.12      | 161.08       | 249.27                | 335.19                          | 406.46     |                           | (97)  |
|                                 | ating require                | 1          |                    |           |            |          |             |              | <u> </u>              | <i>.</i>                        | 00.0       | l                         |       |
| (98)m= 87.4                     | 45 62.34                     | 42.78      | 14.54              | 2.19      | 0          | 0        | 0           | 0            | 9.65                  | 46.85                           | 92.6       | 050.4                     |       |
|                                 |                              |            |                    |           |            |          | lota        | l per year   | (kWh/year             | ) = Sum(9                       | 8)15,912 = | 358.4                     | (98)  |
| Space hea                       | ating require                | ement in   | kWh/m <sup>2</sup> | /year     |            |          |             |              |                       |                                 |            | 7.2                       | (99)  |
| 9a. Energy                      | requiremer                   | nts – Indi | vidual h           | eating s  | ystems i   | ncluding | micro-C     | HP)          |                       |                                 |            |                           |       |
| Space he                        | -                            |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
|                                 | f space hea                  |            |                    |           | mentary    | system   |             |              |                       |                                 |            | 0                         | (201) |
| Fraction of                     | f space hea                  | at from m  | nain syst          | em(s)     |            |          | (202) = 1 - | - (201) =    |                       |                                 |            | 1                         | (202) |
| Fraction of                     | f total hea <mark>ti</mark>  | ng from    | main sys           | stem 1    |            |          | (204) = (20 | 02) × [1 – ( | (203)] =              |                                 |            | 1                         | (204) |
| Eff <mark>icienc</mark> y       | of main s <mark>p</mark> a   | ace heat   | ing syste          | em 1      |            |          |             |              |                       |                                 |            | 89.9                      | (206) |
| Eff <mark>icienc</mark> y       | of seconda                   | ry/suppl   | ementar <u>;</u>   | y heating | g system   | n, %     |             |              |                       |                                 |            | 0                         | (208) |
| Ja                              | n Feb                        | Mar        | Apr                | May       | Jun        | Jul      | Aug         | Sep          | Oct                   | Nov                             | Dec        | kWh/ye                    | ear   |
| Space hea                       | ating require                | ement (c   | alculate           | d above)  | )          |          |             |              |                       |                                 |            |                           |       |
| 87.4                            | 45 62.34                     | 42.78      | 14.54              | 2.19      | 0          | 0        | 0           | 0            | 9.65                  | 46.85                           | 92.6       |                           |       |
| (211)m = {[                     | (98)m x (20                  | 04)] } x 1 | 00 ÷ (20           | )6)       |            |          |             |              |                       |                                 |            | -                         | (211) |
| 97.2                            | 69.34                        | 47.59      | 16.17              | 2.44      | 0          | 0        | 0           | 0            | 10.73                 | 52.12                           | 103        |                           |       |
|                                 |                              | •          |                    |           |            |          | Tota        | l (kWh/yea   | ar) =Sum(2            | 2 <b>11)</b> <sub>15,1012</sub> | .=         | 398.67                    | (211) |
| Space hea                       | ating fuel (s                | econdar    | y), kWh/           | month     |            |          |             |              |                       |                                 |            |                           |       |
| = {[(98)m x                     | (201)] } x 1                 | 00 ÷ (20   | 8)                 |           | r          |          |             |              |                       |                                 |            |                           |       |
| <mark>(215)m=</mark> 0          | 0                            | 0          | 0                  | 0         | 0          | 0        | 0           | 0            | 0                     | 0                               | 0          |                           | _     |
|                                 |                              |            |                    |           |            |          | Tota        | l (kWh/yea   | ar) =Sum(2            | 215) <sub>15,1012</sub>         | <u>_</u>   | 0                         | (215) |
| Water heat                      | -                            |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
| Output from                     |                              |            |                    |           | 00.40      | 0470     | 05.50       | 00.40        | 440.00                | 440.04                          | 400.00     | l                         |       |
|                                 |                              | 120.98     | 106.58             | 103.1     | 90.18      | 84.76    | 95.56       | 96.19        | 110.62                | 119.31                          | 128.98     |                           |       |
| Efficiency o                    |                              | r          | 07.07              | 00.70     | 007        | 00.7     | 0.07        | 00.7         | 00.05                 | 07.50                           | 00.04      | 86.7                      | (216) |
| (217)m= 87.9                    |                              | 87.51      | 87.07              | 86.76     | 86.7       | 86.7     | 86.7        | 86.7         | 86.95                 | 87.58                           | 88.01      |                           | (217) |
| Fuel for wa<br>(219)m = (       | •                            |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
| (219)m = 151.                   |                              | 138.24     | 122.41             | 118.82    | 104.01     | 97.76    | 110.21      | 110.94       | 127.22                | 136.24                          | 146.55     |                           |       |
| L                               |                              |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
|                                 |                              | -          |                    |           |            |          | Tota        | I = Sum(21   | 19a) <sub>112</sub> = |                                 |            | 1496.11                   | (219) |
| Annual tot                      | als                          | •          |                    |           |            |          | Tota        | I = Sum(2'   |                       | Nh/year                         |            | 1496.11<br><b>kWh/yea</b> |       |
| <b>Annual tot</b><br>Space heat |                              | ed, main   | system             | 1         |            |          | Tota        | I = Sum(2′   |                       | Wh/year                         |            |                           |       |

| Water heating fuel used                             |                           |                                   |        | 1496.11                        | ]      |
|---|---------------------------|-----------------------------------|--------|--------------------------------|--------|
| Electricity for pumps, fans and electric keep-hot   |                           |                                   |        |                                |        |
| mechanical ventilation - balanced, extract or posit | ive input from ou         | utside                            | 116.96 |                                | (230a) |
| central heating pump:                               |                           |                                   | 30     |                                | (230c) |
| boiler with a fan-assisted flue                     |                           |                                   | 45     |                                | (230e) |
| Total electricity for the above, kWh/year           |                           | sum of (230a)(230g) =             |        | 191.96                         | (231)  |
| Electricity for lighting                            |                           |                                   |        | 313.91                         | (232)  |
| 12a. CO2 emissions – Individual heating systems     | including micro-          | CHP                               |        |                                |        |
|   | <b>Energy</b><br>kWh/year | <b>Emission fac</b><br>kg CO2/kWh | ctor   | <b>Emissions</b><br>kg CO2/yea | ır     |
| Space heating (main system 1)                       | (211) x                   | 0.216                             | =      | 86.11                          | (261)  |
| Space heating (secondary)                           | (215) x                   | 0.519                             | =      | 0                              | (263)  |
| Water heating                                       | (219) x                   | 0.216                             | =      | 323.16                         | (264)  |
| Space and water heating                             | (261) + (262) + (26       | 63) + (264) =                     |        | 409.27                         | (265)  |
| Electricity for pumps, fans and electric keep-hot   | (231) x                   | 0.519                             | =      | 99.62                          | (267)  |
| Electricity for lighting                            | (232) x                   | 0.519                             | =      | 162.92                         | (268)  |
| Total CO2, kg/year                                  |                           | sum of (265)(271) =               |        | 6 <mark>71.81</mark>           | (272)  |
| Dwelling CO2 Emission Rate                          |                           | (272) ÷ (4) =                     |        | 13.49                          | (273)  |
| El rating (section 14)                              |                           |                                   |        | 91                             | (274)  |

|  |                               |                         | User De      | etails:                      |            |                 |                       |           |                                       |              |
|--|-------------------------------|-------------------------|--------------|------------------------------|------------|-----------------|-----------------------|-----------|---------------------------------------|--------------|
| Assessor Name:<br>Software Name:   | Stroma FSAP 201               |                         | ;            | Stroma<br>Softwa<br>\ddress: | re Ver     |                 |                       | Versio    | n: 1.0.4.23                           |              |
| Addross I  | 3 Bed Flat, 219-223           |                         |              |                              |            | nh lunct        | ion I ON              |           |                                       |              |
| Address :<br>1. Overall dwelling dimer   |                               | Columati                |              | ie, Loug                     | προιοαί    | JII JUIICI      | ION, LON              |           |                                       |              |
| Ground floor   |                               |                         | <b>Area</b>  |                              | (1a) x     | <b>Av. He</b> i | <b>ight(m)</b><br>2.5 | (2a) =    | <b>Volume(m<sup>3</sup>)</b><br>231.5 | (3a)         |
| Total floor area TFA = (1a   | )+(1b)+(1c)+(1d)+(1e          | e)+(1n)                 | 9            | 2.6                          | (4)        |                 |                       |           |                                       |              |
| Dwelling volume  |                               |                         |              |                              | (3a)+(3b)  | +(3c)+(3d       | l)+(3e)+              | .(3n) =   | 231.5                                 | (5)          |
| 2. Ventilation rate:   |                               |                         |              |                              |            |                 |                       |           |                                       |              |
| Number of chimneys   |                               | econdary<br>eating<br>0 | ′ (<br>] + [ | other                        | 1 = [      | <b>total</b>    | x 4                   | 40 =      | m <sup>3</sup> per hour               | (6a)         |
| Number of open flues   | 0 +                           | 0                       | ] + [        | 0                            | ] = [      | 0               | x2                    | 20 =      | 0                                     | (6b)         |
| Number of intermittent far   | IS                            |                         |              |                              | Ĺ          | 0               | x ´                   | 10 =      | 0                                     | (7a)         |
| Number of passive vents  |                               |                         |              |                              |            | 0               | x^                    | 10 =      | 0                                     | _<br>(7b)    |
| Number of flueless gas fir   | es                            |                         |              |                              |            | 0               | X 4                   | 40 =      | 0                                     | (7c)         |
|  |                               |                         |              |                              |            |                 |                       | Air ch    | anges per ho                          | ur           |
| Infiltration due to chimney  |                               |                         |              |                              |            | 0               |                       | ÷ (5) =   | 0                                     | (8)          |
| Number of storeys in th<br>Additional infiltration   | e dw <mark>elling</mark> (ns) |                         |              |                              |            |                 |                       | -1]x0.1 = | 0                                     | (9)<br>(10)  |
| Structural infiltration: 0.2<br>if both types of wall are pre-<br>deducting areas of opening | esent, use the value corres   |                         |              |                              |            | uction          |                       |           | 0                                     | (11)         |
| If suspended wooden fle  | oor, enter 0.2 (unseal        | ed) or 0.1              | (sealed      | d), else                     | enter 0    |                 |                       |           | 0                                     | (12)         |
| If no draught lobby, ente  | er 0.05, else enter 0         |                         |              |                              |            |                 |                       |           | 0                                     | (13)         |
| Percentage of windows  | and doors draught st          | ripped                  |              |                              |            |                 |                       |           | 0                                     | (14)         |
| Window infiltration  |                               |                         |              | ).25 - [0.2                  |            |                 | . (45)                |           | 0                                     | (15)         |
| Infiltration rate<br>Air permeability value, o   | 750 overessed in sub          | via motros              |              | (8) + (10) -                 |            |                 |                       | araa      | 0                                     | (16)         |
| If based on air permeabilit  | • • •                         |                         | •            | •                            | •          |                 | invelope              | alea      | 0.1                                   | (17)<br>(18) |
| Air permeability value applies   |                               |                         |              |                              |            | is being us     | sed                   | l         | 0.1                                   |              |
| Number of sides sheltered  | k                             |                         |              |                              |            |                 |                       | [         | 2                                     | (19)         |
| Shelter factor   |                               |                         | (            | 20) = 1 - [                  | 0.075 x (1 | 9)] =           |                       |           | 0.85                                  | (20)         |
| Infiltration rate incorporation  | ng shelter factor             |                         | (            | (21) = (18)                  | x (20) =   |                 |                       |           | 0.08                                  | (21)         |
| Infiltration rate modified fo  |                               | <u> </u>                |              |                              |            |                 | 1                     |           |                                       |              |
| Jan Feb I  | Mar Apr May                   | Jun                     | Jul          | Aug                          | Sep        | Oct             | Nov                   | Dec       |                                       |              |
| Monthly average wind spe   | - i i                         |                         |              |                              |            |                 |                       |           |                                       |              |
| (22)m= 5.1 5   | 4.9 4.4 4.3                   | 3.8                     | 3.8          | 3.7                          | 4          | 4.3             | 4.5                   | 4.7       |                                       |              |
| Wind Factor (22a)m = (22   | ,<br>1 1                      | ,                       | r            |                              |            |                 |                       | ,         |                                       |              |
| (22a)m= 1.27 1.25 1  | .23 1.1 1.08                  | 0.95                    | 0.95         | 0.92                         | 1          | 1.08            | 1.12                  | 1.18      |                                       |              |

| Adjuste  | ed infiltr             | ation rat               | e (allow       | ing for sh                    | elter an    | d wind s      | peed) =         | : (21a) x     | (22a)m       |                |                       |           |           |               |
|----------|------------------------|-------------------------|----------------|-------------------------------|-------------|---------------|-----------------|---------------|--------------|----------------|-----------------------|-----------|-----------|---------------|
|          | 0.11                   | 0.11                    | 0.1            | 0.09                          | 0.09        | 0.08          | 0.08            | 0.08          | 0.08         | 0.09           | 0.1                   | 0.1       |           |               |
|          |                        | ctive air<br>al ventila | -              | rate for t                    | he applic   | cable ca      | se              |               |              |                |                       |           | 0.5       | (23a)         |
|          |                        |                         |                | endix N, (2                   | 3b) = (23a  | ) × Fmv (e    | equation (      | N5)) . othe   | rwise (23b   | ) = (23a)      |                       |           | 0.5       | (23a)         |
|          |                        |                         |                | ciency in %                   |             |               |                 |               |              | , ( ,          |                       |           | 73.1      | (23c)         |
|          |                        |                         | -              | entilation                    | -           |               |                 |               |              | 2h)m + (       | 23b) x [ <sup>/</sup> | 1 – (23c) |           | (200)         |
| (24a)m=  |                        | 0.24                    | 0.24           | 0.23                          | 0.23        | 0.22          | 0.22            | 0.21          | 0.22         | 0.23           | 0.23                  | 0.23      | . 100]    | (24a)         |
|          |                        | d mech                  | ı<br>anical ve | entilation                    | without     | heat rec      | L<br>coverv (l  | 1<br>MV) (24t | (22)         | 1<br>2b)m + () | 1<br>23b)             |           |           |               |
| (24b)m=  | 0                      | 0                       | 0              | 0                             | 0           | 0             | 0               | 0             | 0            | 0              | 0                     | 0         |           | (24b)         |
| c) If    | whole h                | use ex                  | r<br>tract ver | ntilation c                   | r positiv   | e input v     | ı<br>ventilatio | n from o      | utside       |                |                       |           |           |               |
| ,        |                        |                         |                | then (24c                     | •           | •             |                 |               |              | .5 × (23t      | <b>)</b> )            |           |           |               |
| (24c)m=  | 0                      | 0                       | 0              | 0                             | 0           | 0             | 0               | 0             | 0            | 0              | 0                     | 0         |           | (24c)         |
| ,        |                        |                         |                | ole hous                      | •           | •             |                 |               |              |                |                       |           |           |               |
|          | · ,                    | r                       | r <u>, ,</u>   | )m = (22b                     | · · · · · · |               | ,<br>           | 1             | <u> </u>     | r -            | <u> </u>              |           |           |               |
| (24d)m=  | 0                      | 0                       | 0              | 0                             | 0           | 0             | 0               | 0             | 0            | 0              | 0                     | 0         |           | (24d)         |
|          |                        |                         | <b></b>        | nter (24a                     | <u> </u>    | , 、           | ŕ               | <del>,</del>  | r`´´         | 0.00           | 0.00                  | 0.00      |           | (25)          |
| (25)m=   | 0.24                   | 0.24                    | 0.24           | 0.23                          | 0.23        | 0.22          | 0.22            | 0.21          | 0.22         | 0.23           | 0.23                  | 0.23      |           | (25)          |
| 3. Hea   | at l <mark>osse</mark> | s and he                | eat loss       | paramete                      | er:         |               |                 |               |              |                | _                     |           |           |               |
| ELEN     | 1ENT                   | Gros                    |                | Openin<br>m                   |             | Net Ar        |                 | U-val<br>W/m2 |              | AXU            |                       | k-value   |           | A X k<br>kJ/K |
| Window   | ws Type                | are <mark>a</mark>      | (111-)         |                               |             | A ,r<br>10.98 |                 | /[1/( 0.73 )· |              | (W/            |                       | KJ/11-•r  | `         | KJ/K<br>(27)  |
|          | ws Type                |                         |                |                               |             |               |                 | /[1/( 0.73 )· |              |                | H                     |           |           |               |
|          | ws Type                |                         |                |                               |             | 2.7           |                 | /[1/( 0.73 )· |              | 1.92           | 2                     |           |           | (27)          |
| Walls 1  |                        |                         |                |                               |             | 2.7           |                 |               |              | 1.92           | ╘┤╷                   |           |           | (27)          |
|          |                        | 34.                     |                | 10.98                         | 3           | 23.52         |                 | 0.15          | =            | 3.53           | ╡╏                    |           | $\dashv$  | (29)          |
| Walls 7  |                        | 12.                     |                | 2.7                           |             | 9.8           | ×               | 0.15          |              | 1.47           | ╡╎                    |           | $\dashv$  | (29)          |
| Walls 7  |                        | 23.2                    |                | 2.7                           |             | 20.55         |                 | 0.15          | =            | 3.08           |                       |           |           | (29)          |
|          |                        | lements                 | , m²           |                               |             | 70.25         | 5               |               |              |                | —                     |           |           | (31)          |
| Party v  |                        |                         |                |                               |             | 47            | ×               | 0             | =            | 0              | [                     |           | $\dashv$  | (32)          |
| Party fl |                        |                         |                |                               |             | 92.6          |                 |               |              |                | Ĺ                     |           | $\exists$ | (32a)         |
| Party c  | -                      |                         |                |                               |             | 92.6          |                 |               |              |                | Ļ                     |           | $\exists$ | (32b)         |
|          | l wall **              |                         |                |                               |             | 146.5         |                 |               |              |                | Ļ                     |           |           | (32c)         |
|          |                        |                         |                | effective wil<br>nternal wall |             |               | ated using      | g formula 1   | /[(1/U-valu  | ie)+0.04] a    | as given in           | paragraph | 3.2       |               |
|          |                        | s, W/K                  |                |                               | ,           |               |                 | (26)(30       | ) + (32) =   |                |                       |           | 19.7      | (33)          |
| Heat ca  | apacity                | Cm = S(                 | (Axk)          |                               |             |               |                 |               | ((28).       | (30) + (32     | 2) + (32a).           | (32e) =   | 19835.    | 1 (34)        |
| Therma   | al mass                | parame                  | eter (TMI      | P = Cm ÷                      | - TFA) in   | kJ/m²K        |                 |               | Indica       | tive Value     | : Medium              |           | 250       | (35)          |
|          | -                      |                         |                | etails of the                 | constructi  | on are not    | t known p       | recisely the  | e indicative | e values of    | TMP in Ta             | able 1f   |           |               |
|          |                        | ad of a de              |                |                               |             | ا المعامم     | /               |               |              |                |                       | 1         |           |               |
|          | -                      |                         |                | lculated u                    |             |               | ^               |               |              |                |                       |           | 7.32      | (36)          |
|          | abric he               |                         | are not Kr     | 10wn (36) =                   | 0.00 X (3   | 1)            |                 |               | (33) +       | (36) =         |                       |           | 27.02     | (37)          |
|          |                        |                         |                |                               |             |               |                 |               |              |                |                       |           |           | ` ,           |

| Ventila        | ation he                                     | at loss c              | alculate                | d monthl                             | у                        |                         |                       |                          | (38)m              | = 0.33 × (             | 25)m x (5)                            |         |         |              |
|----------------|--|------------------------|-------------------------|--------------------------------------|--------------------------|-------------------------|-----------------------|--------------------------|--------------------|------------------------|---------------------------------------|---------|---------|--------------|
|                | Jan  | Feb                    | Mar                     | Apr                                  | May                      | Jun                     | Jul                   | Aug                      | Sep                | Oct                    | Nov                                   | Dec     |         |              |
| (38)m=         | 18.55  | 18.39                  | 18.23                   | 17.42                                | 17.26                    | 16.44                   | 16.44                 | 16.28                    | 16.77              | 17.26                  | 17.58                                 | 17.91   |         | (38)         |
| Heat t         | ransfer                                      | coefficie              | nt, W/K                 |                                      |                          |                         |                       |                          | (39)m              | = (37) + (             | 38)m                                  |         |         |              |
| (39)m=         | 45.57  | 45.41                  | 45.25                   | 44.44                                | 44.27                    | 43.46                   | 43.46                 | 43.3                     | 43.79              | 44.27                  | 44.6                                  | 44.92   |         | _            |
| Heat l         | oss para                                     | ameter (               | HLP), W                 | /m²K                                 |                          |                         |                       |                          |                    | Average =<br>= (39)m ÷ | Sum(39) <sub>1.</sub>                 | 12 /12= | 44.4    | (39)         |
| (40)m=         | 0.49   | 0.49                   | 0.49                    | 0.48                                 | 0.48                     | 0.47                    | 0.47                  | 0.47                     | 0.47               | 0.48                   | 0.48                                  | 0.49    |         |              |
| Numb           | er of da                                     | vs in mo               | onth (Tab               | le 1a)                               | 1                        | 1                       | 1                     | 1                        | 1                  | Average =              | Sum(40)1                              | 12 /12= | 0.48    | (40)         |
|                | Jan  | Feb                    | Mar                     | Apr                                  | May                      | Jun                     | Jul                   | Aug                      | Sep                | Oct                    | Nov                                   | Dec     |         |              |
| (41)m=         | 31   | 28                     | 31                      | 30                                   | 31                       | 30                      | 31                    | 31                       | 30                 | 31                     | 30                                    | 31      |         | (41)         |
|                |  | Į                      |                         |                                      | <b>!</b>                 |                         |                       | <b></b>                  |                    | ļ                      |                                       |         |         |              |
| 4. Wa          | ater hea                                     | ting ene               | ergy requ               | irement:                             |                          |                         |                       |                          |                    |                        |                                       | kWh/ye  | ear:    |              |
| if TF<br>if TF | <sup>-</sup> A > 13.<br><sup>-</sup> A £ 13. | 9, N = 1               | + 1.76 >                |                                      | o(-0.0003                | ,                       |                       | , ,-                     |                    | TFA -13                | .9)                                   | 66      |         | (42)         |
| Reduce         | the annu                                     | ge not w<br>al average | ater usa<br>e hot water | ge in litre<br><sup>•</sup> usage by | es per da<br>5% if the c | ay va,av<br>Iwelling is | erage =<br>designed : | (25 X N)<br>to achieve   | + 36<br>a water us | se target o            | 97<br>f                               | .37     |         | (43)         |
| not mor        | e that 125                                   | 5 litres per           | person pe               | r day (all w                         | vater use, l             | hot and co              | ld)                   |                          |                    |                        | _                                     |         |         |              |
|                | Jan  | Feb                    | Mar                     | Apr                                  | May                      | Jun                     | Jul                   | Aug                      | Sep                | Oct                    | Nov                                   | Dec     |         |              |
| Hot wat        | er usage                                     | in litres pe           | er day for e            | ach m <mark>onth</mark>              | Vd,m = fa                | ctor from T             | Table 1c x            | (43)                     |                    |                        |                                       |         |         |              |
| (44)m=         | 107.1  | 103.21                 | 99.31                   | 95.42                                | 91.52                    | 87.63                   | 87.63                 | 91.52                    | 95.42              | 9 <mark>9.31</mark>    | 103.21                                | 107.1   |         | _            |
| Energy         | content o                                    | f hot water            | r used - ca             | lculated m                           | onthly = 4.              | 190 x Vd,r              | n x nm x E            | 0Tm / 3600               |                    |                        | m(44) <sub>112</sub> =<br>ables 1b, 1 |         | 1168.4  | (44)         |
| (45)m=         | 158.83                                       | 138.92                 | 143.35                  | 124 <mark>.</mark> 97                | 119.92                   | 103.48                  | 95.8 <mark>9</mark>   | 110.03                   | 111.35             | 12 <mark>9.76</mark>   | 141.65                                | 153.82  |         |              |
| lf instar      | ntaneous v                                   | vater heat             | ing at poin             | t of use (ne                         | o hot wate               | r storage),             | enter 0 in            | boxes (46                |                    | Total = Su             | m(45) <sub>112</sub> =                | -       | 1531.96 | (45)         |
| (46)m=         | 23.82  | 20.84                  | 21.5                    | 18.75                                | 17.99                    | 15.52                   | 14.38                 | 16.5                     | 16.7               | 19.46                  | 21.25                                 | 23.07   |         | (46)         |
|                | storage                                      |                        |                         | •                                    |                          |                         |                       |                          |                    |                        |                                       |         |         |              |
| -              |  |                        |                         | • •                                  | olar or W                |                         | -                     |                          | ame ves            | sel                    |                                       | 0       |         | (47)         |
| Other          | wise if n                                    | o stored               |                         |                                      | velling, e<br>ncludes i  |                         |                       | . ,                      | ers) ente          | er '0' in (            | 47)                                   |         |         |              |
|                | storage<br>nanufac                           |                        | eclared                 | loss fact                            | or is kno                | wn (kWł                 | n/dav):               |                          |                    |                        |                                       | 0       |         | (48)         |
|                |  |                        | om Table                |                                      |                          |                         | "day).                |                          |                    |                        |                                       | 0       |         | (49)         |
| •              |  |                        |                         | e, kWh/y                             | ear                      |                         |                       | (48) x (49)              | ) =                |                        |                                       | 0       |         | (50)         |
| •              | -  |                        | •                       | •                                    | loss fact                | or is not               |                       | ( -/ ( -)                | ,<br>              |                        |                                       | 0       |         | (00)         |
|                |  | -                      |                         |                                      | le 2 (kW                 | h/litre/da              | ay)                   |                          |                    |                        |                                       | 0       |         | (51)         |
|                |  |                        | see section             | ion 4.3                              |                          |                         |                       |                          |                    |                        |                                       |         | I       | (50)         |
|                |  | from Ta                | om Table                | 2h                                   |                          |                         |                       |                          |                    |                        |                                       | 0<br>0  |         | (52)<br>(53) |
|                |  |                        |                         | , kWh/y                              | ear                      |                         |                       | (47) x (51)              | ) x (52) v (       | 53) -                  |                                       |         |         |              |
| -              | •  | (54) in (              | -                       | -, πνντι/y                           | cai                      |                         |                       | ( <sup>-+</sup> ) ^ (J1) | , ^ (32) ^ (       |                        |                                       | 0<br>0  |         | (54)<br>(55) |
|                | . ,  | . , .                  | ,                       | for each                             | month                    |                         |                       | ((56)m = (               | 55) × (41)         | m                      | L                                     | -       | I       | x/           |
| (56)m=         | 0  | 0                      | 0                       | 0                                    | 0                        | 0                       | 0                     | 0                        | 0                  | 0                      | 0                                     | 0       |         | (56)         |
|                | I  | ı                      | 1                       | 1                                    |                          | 1                       | 1                     | 1                        | 1                  |                        | 1                                     | 1       |         |              |

| If cylinder contair         | ns dedicate              | d solar sto | rage, (57)r | m = (56)m   | x [(50) – (       | H11)] ÷ (5               | 0), else (5  | 7)m = (56)    | m where (                 | H11) is fro | m Append    | ix H         |      |
|-----------------------------|--------------------------|-------------|-------------|-------------|-------------------|--------------------------|--------------|---------------|---------------------------|-------------|-------------|--------------|------|
| (57)m= 0                    | 0                        | 0           | 0           | 0           | 0                 | 0                        | 0            | 0             | 0                         | 0           | 0           |              | (57) |
| Primary circui              | t loss (an               | inual) fro  | om Table    | e 3         | -                 |                          | -            |               | -                         |             | 0           |              | (58) |
| Primary circui              |                          |             |             |             | 59)m = (          | (58) ÷ 36                | 65 × (41)    | m             |                           |             |             |              |      |
| (modified b                 | y factor fi              | om Tab      | e H5 if t   | here is s   | solar wat         | er heatir                | ng and a     | cylinde       | r thermo                  | stat)       |             | L            |      |
| (59)m= 0                    | 0                        | 0           | 0           | 0           | 0                 | 0                        | 0            | 0             | 0                         | 0           | 0           |              | (59) |
| Combi loss ca               | alculated                | for each    | month (     | 61)m =      | (60) ÷ 36         | 65 × (41)                | )m           |               |                           |             |             |              |      |
| (61)m= 11.85                | 10.7                     | 11.83       | 11.42       | 11.78       | 11.38             | 11.74                    | 11.77        | 11.4          | 11.81                     | 11.45       | 11.85       |              | (61) |
| Total heat rec              | uired for                | water he    | eating ca   | alculated   | l for eacl        | n month                  | (62)m =      | 0.85 × (      | (45)m +                   | (46)m +     | (57)m +     | (59)m + (61) | m    |
| (62)m= 170.69               | 149.62                   | 155.18      | 136.39      | 131.7       | 114.86            | 107.63                   | 121.8        | 122.75        | 141.57                    | 153.1       | 165.67      |              | (62) |
| Solar DHW input             | calculated               | using App   | endix G or  | Appendix    | H (negati         | ve quantity              | /) (enter '0 | if no sola    | r contribut               | ion to wate | er heating) |              |      |
| (add additiona              | al lines if              | FGHRS       | and/or V    | VWHRS       | applies           | , see Ap                 | pendix (     | G)            | -                         | -           |             |              |      |
| (63)m= 0                    | 0                        | 0           | 0           | 0           | 0                 | 0                        | 0            | 0             | 0                         | 0           | 0           |              | (63) |
| Output from w               | vater hea                | ter         |             |             |                   |                          |              |               |                           |             |             |              |      |
| <mark>(64)m=</mark> 170.69  | 149.62                   | 155.18      | 136.39      | 131.7       | 114.86            | 107.63                   | 121.8        | 122.75        | 141.57                    | 153.1       | 165.67      |              | _    |
|                             |                          |             |             |             |                   |                          | Outp         | out from wa   | ater heate                | r (annual)₁ | 12          | 1670.94      | (64) |
| Heat gains fro              | om water                 | heating,    | kWh/mo      |             | 5´[0.85           | × (45)m                  |              | ı] + 0.8 x    | ( <mark>(46)m</mark>      | + (57)m     | + (59)m     | ]            |      |
| (65)m= 55.78                | 48.86                    | 50.62       | 44.41       | 42.82       | 37.25             | 34.82                    | 39.53        | 39.87         | 46.1                      | 49.96       | 54.11       |              | (65) |
| in <mark>clude</mark> (57)  | )m in c <mark>alc</mark> | culation of | of (65)m    | only if c   | ylinder is        | s in th <mark>e</mark> o | dwelling     | or hot w      | ate <mark>r is f</mark> r | om com      | munity h    | eating       |      |
| 5. Internal g               | ains (see                | Table 5     | and 5a      | ):          |                   |                          |              |               |                           |             |             |              |      |
| Met <mark>abolic</mark> gai |                          | 5), Wat     | ts          |             |                   |                          |              |               |                           |             |             |              |      |
| Jan                         | Feb                      | Mar         | Apr         | May         | Jun               | Jul                      | Aug          | Sep           | Oct                       | Nov         | Dec         |              | ()   |
| (66)m= 132.98               |                          | 132.98      | 132.98      | 132.98      | 132.98            | 132.98                   | 132.98       | 132.98        | 132.98                    | 132.98      | 132.98      |              | (66) |
| Lighting gains              | ì                        |             | ·           | · ·         | i                 | ,                        | i            |               | i                         | i           | i           | I            |      |
| (67)m= 30.46                | 27.06                    | 22          | 16.66       | 12.45       | 10.51             | 11.36                    | 14.76        | 19.82         | 25.16                     | 29.37       | 31.31       |              | (67) |
| Appliances ga               | 1                        | ulated in   | Append      | lix L, eq   | uation L          | 13 or L1                 | 3a), alsc    | see Ta        | ble 5                     |             |             | I            |      |
| (68)m= 243.78               |                          | 239.94      |             | 209.23      | 193.13            | 182.38                   | 179.85       | 186.22        | 199.79                    | 216.92      | 233.02      |              | (68) |
| Cooking gains               | 1                        |             | · ·         |             |                   |                          |              |               |                           | r           | · · · · ·   | I            |      |
| (69)m= 36.3                 | 36.3                     | 36.3        | 36.3        | 36.3        | 36.3              | 36.3                     | 36.3         | 36.3          | 36.3                      | 36.3        | 36.3        |              | (69) |
| Pumps and fa                | 1                        | <u> </u>    |             |             |                   |                          |              |               | ·                         | ·           |             | I            |      |
| (70)m= 3                    | 3                        | 3           | 3           | 3           | 3                 | 3                        | 3            | 3             | 3                         | 3           | 3           |              | (70) |
| Losses e.g. e               | · ·                      |             |             | , (         | ,<br>             |                          |              |               |                           |             |             | 1            |      |
| (71)m= -106.39              |                          | -106.39     | -106.39     | -106.39     | -106.39           | -106.39                  | -106.39      | -106.39       | -106.39                   | -106.39     | -106.39     |              | (71) |
| Water heating               | g gains (T               | able 5)     |             |             |                   |                          |              |               |                           |             |             | I            |      |
| (72)m= 74.97                | 72.71                    | 68.04       | 61.68       | 57.55       | 51.74             | 46.8                     | 53.13        | 55.38         | 61.96                     | 69.39       | 72.72       |              | (72) |
| Total interna               | -                        |             |             |             | · · ·             |                          | n + (68)m +  |               | 1                         | 1)m + (72)  | i           | 1            |      |
| (73)m= 415.1                | 411.98                   | 395.87      | 370.6       | 345.13      | 321.28            | 306.43                   | 313.64       | 327.31        | 352.81                    | 381.58      | 402.95      |              | (73) |
| 6. Solar gain               |                          |             | e flans for | Takle Or    | and               | atod a mi                | tions to -   | D. 10 - 1 - 1 | o oraliaat                |             | ion         |              |      |
| Solar gains are             |                          | -           |             | i adie 6a a | and associ<br>Flu |                          | mons to co   |               | e applicat                | FF          | 1011.       | Gains        |      |
| Orientation:                | Access F<br>Table 6d     | acior       | Area<br>m²  |             |                   | x<br>ole 6a              | Т            | g_<br>able 6b | Та                        | able 6c     |             | Gains<br>(W) |      |

| Northeast 0.9x 0.77            | × | 2.7   | x | 11.28               | ×        | 0.63 | x | 0.1 | ] = | 1.33  | (75) |
|--------------------------------|---|-------|---|---------------------|----------|------|---|-----|-----|-------|------|
| Northeast 0.9x 0.77            | x | 2.7   | x | 22.97               | ×        | 0.63 | x | 0.1 | i = | 2.71  | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 41.38               | ×        | 0.63 | x | 0.1 | =   | 4.88  | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 67.96               | x        | 0.63 | x | 0.1 | ] = | 8.01  | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 91.35               | ×        | 0.63 | x | 0.1 | ] = | 10.77 | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 97.38               | x        | 0.63 | x | 0.1 | =   | 11.48 | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 91.1                | x        | 0.63 | x | 0.1 | =   | 10.74 | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 72.63               | x        | 0.63 | x | 0.1 | =   | 8.56  | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 50.42               | x        | 0.63 | x | 0.1 | ] = | 5.94  | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 28.07               | x        | 0.63 | x | 0.1 | ] = | 3.31  | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 14.2                | x        | 0.63 | x | 0.1 | ] = | 1.67  | (75) |
| Northeast 0.9x 0.77            | x | 2.7   | x | 9.21                | ×        | 0.63 | x | 0.1 | =   | 1.09  | (75) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 36.79               | x        | 0.63 | x | 0.1 | ] = | 4.34  | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 62.67               | ×        | 0.63 | x | 0.1 | =   | 7.39  | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 85.75               | ×        | 0.63 | x | 0.1 | =   | 10.11 | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 106.25              | ×        | 0.63 | x | 0.1 | =   | 12.52 | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 119.01              | x        | 0.63 | x | 0.1 | =   | 14.03 | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | X | 118.15              | x        | 0.63 | x | 0.1 | ] = | 13.93 | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 113.91              | <b>x</b> | 0.63 | x | 0.1 | =   | 13.43 | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 104.39              | ] ×      | 0.63 | x | 0.1 | =   | 12.31 | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 92.85               | x        | 0.63 | x | 0.1 | =   | 10.95 | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | × | 69.2 <mark>7</mark> | x        | 0.63 | x | 0.1 | =   | 8.17  | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 44.07               | ×        | 0.63 | x | 0.1 | =   | 5.2   | (77) |
| Southeast 0.9x 0.77            | x | 2.7   | x | 31.49               | x        | 0.63 | x | 0.1 | =   | 3.71  | (77) |
| Southwest0.9x 0.77             | x | 10.98 | x | 36.79               | ]        | 0.63 | x | 0.1 | =   | 17.64 | (79) |
| Southwest0.9x 0.77             | x | 10.98 | x | 62.67               | ]        | 0.63 | x | 0.1 | =   | 30.04 | (79) |
| Southwest0.9x 0.77             | x | 10.98 | x | 85.75               | ]        | 0.63 | x | 0.1 | =   | 41.11 | (79) |
| Southwest0.9x 0.77             | x | 10.98 | x | 106.25              | ]        | 0.63 | x | 0.1 | =   | 50.93 | (79) |
| Southwest0.9x 0.77             | x | 10.98 | x | 119.01              | ]        | 0.63 | x | 0.1 | =   | 57.05 | (79) |
| Southwest0.9x 0.77             | x | 10.98 | x | 118.15              | ]        | 0.63 | x | 0.1 | =   | 56.64 | (79) |
| Southwest <sub>0.9x</sub> 0.77 | x | 10.98 | x | 113.91              | ]        | 0.63 | x | 0.1 | ] = | 54.61 | (79) |
| Southwest <sub>0.9x</sub> 0.77 | x | 10.98 | x | 104.39              | ]        | 0.63 | x | 0.1 | ] = | 50.04 | (79) |
| Southwest0.9x 0.77             | x | 10.98 | × | 92.85               | ]        | 0.63 | x | 0.1 | ] = | 44.51 | (79) |
| Southwest0.9x 0.77             | × | 10.98 | x | 69.27               | ]        | 0.63 | x | 0.1 | =   | 33.21 | (79) |
| Southwest <sub>0.9x</sub> 0.77 | x | 10.98 | x | 44.07               | ]        | 0.63 | x | 0.1 | ] = | 21.13 | (79) |
| Southwest <sub>0.9x</sub> 0.77 | x | 10.98 | x | 31.49               | ]        | 0.63 | x | 0.1 | ] = | 15.09 | (79) |

| Solar g  | ains in  | watts, ca | alculated | for eac   | n month     |           |          | (83)m = S | um(74)m . | (82)m  |        |        | _        |      |
|--|--|-----------|-----------|-----------|-------------|-----------|----------|-----------|-----------|--------|--------|--------|----------|------|
| (83)m=   | 23.31  | 40.14     | 56.09     | 71.47     | 81.85       | 82.05     | 78.77    | 70.91     | 61.4      | 44.68  | 27.99  | 19.89  |          | (83) |
| Total g  | Total gains – internal and solar (84)m = (73)m + (83)m , watts |           |           |           |             |           |          |           |           |        |        |        |          |      |
| (84)m=   | 438.41   | 452.11    | 451.97    | 442.07    | 426.98      | 403.32    | 385.2    | 384.54    | 388.71    | 397.49 | 409.57 | 422.84 |          | (84) |
| 7. Mean internal temperature (heating season)  |  |           |           |           |             |           |          |           |           |        |        |        |          |      |
| Temp   | erature  | during h  | eating p  | eriods ir | n the livir | ng area f | from Tab | ole 9, Th | 1 (°C)    |        |        |        | 21       | (85) |
| Utilisation factor for gains for living area, h1,m (see Table 9a)                                    |  |           |           |           |             |           |          |           |           |        |        |        |          |      |
| Stroma ESAM 2012 VErson 1.04.25 (SAM 9.52) - http://www.stuma.com/ul Aug Sep Oct Nov Dec Page 5 of 7 |  |           |           |           |             |           |          |           |           |        |        |        | e 5 of 7 |      |

|   | 1             |
|---|---------------|
| (86)m=         1         1         0.99         0.98         0.9         0.69         0.5         0.52         0.77         0.97         1         1  | (86)          |
| Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)   |               |
| (87)m= 20.63 20.68 20.76 20.88 20.97 21 21 21 20.99 20.91 20.76 20.62   | (87)          |
| Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)   |               |
| (88)m= 20.53 20.53 20.53 20.54 20.54 20.55 20.55 20.55 20.55 20.54 20.54 20.53  | (88)          |
| Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)  |               |
| (89)m= 1 1 0.99 0.97 0.87 0.64 0.45 0.47 0.72 0.95 0.99 1   | (89)          |
| Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)  | I             |
| (90)m= 20.02 20.09 20.22 20.39 20.51 20.55 20.55 20.54 20.44 20.21 20.01  | (90)          |
| fLA = Living area ÷ (4) =   | 0.35 (91)     |
| Many interval target and (for the sub-size duality $r$ ) of $A$ , $TA$ , $(A = \{1, A\}) \in TO$  |               |
| Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$<br>(92)m= 20.23 20.3 20.41 20.56 20.67 20.71 20.71 20.71 20.7 20.6 20.4 20.22                                    | (92)          |
| Apply adjustment to the mean internal temperature from Table 4e, where appropriate  | (02)          |
| (93)m= 20.08 20.15 20.26 20.41 20.52 20.56 20.56 20.56 20.55 20.45 20.25 20.07  | (93)          |
| 8. Space heating requirement  |               |
| Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calc   | culate        |
| the utilisation factor for gains using Table 9a   |               |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec   |               |
| Utilisation factor for gains, hm:   | ,             |
| (94)m=         1         1         0.99         0.96         0.87         0.64         0.45         0.47         0.72         0.95         0.99         1   | (94)          |
| Useful gains, hmGm , $W = (94)$ m x (84)m   |               |
| (95)m= 437.41 450.27 447.52 426.52 370.61 258.1 171.97 180.03 279.93 377.77 406.8 422.14  | (95)          |
| Monthly average external temperature from Table 8           (96)m=         4.3         4.9         6.5         8.9         11.7         14.6         16.4         14.1         10.6         7.1         4.2 | (96)          |
| Heat loss rate for mean internal temperature, Lm , $W = [(39)m \times [(93)m - (96)m]$  | (30)          |
| (97)m= 719.23 692.38 622.48 511.43 390.41 258.85 171.99 180.05 282.45 436.25 586.61 713   | (97)          |
| Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$   |               |
| (98)m= 209.67 162.7 130.17 61.14 14.74 0 0 0 0 43.51 129.46 216.39  |               |
| Total per year (kWh/year) = Sum(98) <sub>15912</sub> =  | 967.79 (98)   |
| Space heating requirement in kWh/m²/year  | 10.45 (99)    |
| 9a. Energy requirements – Individual heating systems including micro-CHP)   |               |
| Space heating:  |               |
| Fraction of space heat from secondary/supplementary system  | 0 (201)       |
| Fraction of space heat from main system(s) $(202) = 1 - (201) =$  | 1 (202)       |
| Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$   | 1 (204)       |
| Efficiency of main space heating system 1   | 89.9 (206)    |
|   |               |
| Efficiency of secondary/supplementary heating system, %   | 0 (208)       |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec   | kWh/year      |
| Space heating requirement (calculated above)  | 1             |
| 209.67         162.7         130.17         61.14         14.74         0         0         0         43.51         129.46         216.39   | 1             |
| $(211)m = \{ [(98)m \times (204)] \} \times 100 \div (206)$   | (211)         |
| 233.23 180.98 144.8 68.01 16.39 0 0 0 0 48.4 144.01 240.7<br>Total (kWh/year) =Sum(211) <sub>1.6.51012</sub> =  | 4070 50 (211) |
|   | 1076.52 (211) |

Space heating fuel (secondary), kWh/month

| $= \{[(08)m \times (201)]\} \times 100 + (208)$                              |                 |                        |             |            |                        |                         |        |                        |                       |
|--|-----------------|------------------------|-------------|------------|------------------------|-------------------------|--------|------------------------|-----------------------|
| $= \{ [(98)m \times (201)] \} \times 100 \div (208) \\ (215)m = 0 0 0 0 0$   | 0 0             | 0                      | 0           | 0          | 0                      | 0                       | 0      |                        |                       |
|  | <u> </u>        |                        | -           | l (kWh/yea | -                      | -                       | -      | 0                      | (215)                 |
| Water heating  |                 |                        |             |            |                        |                         | I      |                        |                       |
| Output from water heater (calculated abov                                    |                 |                        |             |            |                        |                         |        | I                      |                       |
|  | 31.7 114.86     | 107.63                 | 121.8       | 122.75     | 141.57                 | 153.1                   | 165.67 |                        | _                     |
| Efficiency of water heater   |                 |                        |             |            |                        |                         |        | 86.7                   | (216)                 |
|  | 7.01 86.7       | 86.7                   | 86.7        | 86.7       | 87.43                  | 88.14                   | 88.48  |                        | (217)                 |
| Fuel for water heating, kWh/month<br>(219)m = $(64)m \times 100 \div (217)m$ |                 |                        |             |            |                        |                         |        |                        |                       |
|  | 1.35 132.47     | 124.14                 | 140.48      | 141.58     | 161.92                 | 173.71                  | 187.23 |                        |                       |
|  | •               |                        | Tota        | l = Sum(2  | 19a) <sub>112</sub> =  |                         | •      | 1906.93                | (219)                 |
| Annual totals  |                 |                        |             |            | k                      | Wh/yea                  | ŗ      | kWh/yea                | r                     |
| Space heating fuel used, main system 1                                       |                 |                        |             |            |                        |                         |        | 1076.52                |                       |
| Water heating fuel used  |                 |                        |             |            |                        |                         |        | 1906.93                |                       |
| Electricity for pumps, fans and electric kee                                 | p-hot           |                        |             |            |                        |                         |        |                        |                       |
| mechanical ventilation - balanced, extrac                                    | t or positive i | nput fron              | n outside   | Э          |                        |                         | 194.17 |                        | (230a)                |
| central heating pump:  |                 |                        |             |            |                        |                         | 30     |                        | (230 <mark>c</mark> ) |
| boi <mark>ler wi</mark> th a fan-assisted flue                               |                 |                        |             |            |                        |                         | 45     |                        | (230e)                |
| Total electricity for th <mark>e above, kWh/year</mark>                      |                 |                        | sum         | of (230a). | <mark>(2</mark> 30g) = |                         |        | 2 <mark>69.17</mark>   | (231)                 |
| Electricity for lighting   |                 |                        |             |            |                        |                         |        | 537.95                 | (232)                 |
| 12a. CO2 emissions – Individual heating                                      | svstems inclu   | udina mi               | cro-CHF     |            |                        |                         |        |                        | ]                     |
|  |                 |                        |             |            |                        |                         |        | _                      |                       |
|  |                 | <b>ergy</b><br>/h/year |             |            | kg CO                  | <b>ion fac</b><br>2/kWh | tor    | Emissions<br>kg CO2/ye |                       |
| Space heating (main system 1)  |                 | 1) x                   |             |            | 0.2                    |                         | =      | 232.53                 | (261)                 |
| Space heating (secondary)  | (21             | 5) x                   |             |            | 0.5                    |                         | =      | 0                      | (263)                 |
| Water heating  | (219            | 9) x                   |             |            | 0.2                    |                         | =      | 411.9                  | (264)                 |
| Space and water heating  | (26             | 1) + (262)             | + (263) + ( | (264) =    |                        |                         |        | 644.42                 | (265)                 |
| Electricity for pumps, fans and electric kee                                 | ep-hot (23      | 1) x                   |             |            | 0.5                    | 19                      | =      | 139.7                  | (267)                 |
| Electricity for lighting   | (232            | 2) x                   |             |            | 0.5                    | 19                      | =      | 279.2                  | (268)                 |
| Total CO2, kg/year   |                 |                        |             | sum o      | f (265)(2              | 271) =                  |        | 1063.32                | (272)                 |
| Dwelling CO2 Emission Rate   |                 |                        |             | (272)      | ÷ (4) =                |                         |        | 11.48                  | (273)                 |
| EI rating (section 14)   |                 |                        |             |            |                        |                         |        | 90                     | (274)                 |
|  |                 |                        |             |            |                        |                         |        |                        |                       |

|   |   | ι                 | User De   | etails:          |                |             |                       |              |                              |              |
|---|---|-------------------|-----------|------------------|----------------|-------------|-----------------------|--------------|------------------------------|--------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 2012  |                   | ;         | Stroma<br>Softwa | re Ver         |             |                       | Versio       | n: 1.0.4.23                  |              |
|   | 2 Bed Flat, 219-223                                     |                   |           | Address:         |                | nh lunat    | ion I ON              |              |                              |              |
| Address :<br>1. Overall dwelling dimer  |   | Columato          | our Lar   | ne, Loug         | προιοαί        | in Junci    | ION, LOP              | NDON         |                              |              |
| Ground floor  |   |                   | Area      |                  | (1a) x         | Av. Hei     | <b>ight(m)</b><br>2.5 | (2a) =       | Volume(m <sup>3</sup><br>192 | )<br>(3a)    |
| Total floor area TFA = (1a  | a)+(1b)+(1c)+(1d)+(1e)                                  | )+(1n)            | 7         | 6.8              | (4)            |             |                       |              |                              |              |
| Dwelling volume   |   |                   |           |                  | (3a)+(3b)      | +(3c)+(3d   | l)+(3e)+              | .(3n) =      | 192                          | (5)          |
| 2. Ventilation rate:  |   |                   |           |                  |                |             |                       |              |                              |              |
|   | heating h   | condary<br>eating |           | other            | , r            | total       |                       |              | m <sup>3</sup> per hou       | _            |
| Number of chimneys  | 0 +   | 0                 | +         | 0                | ] = [<br>] = [ | 0           |                       | 40 =<br>20 = | 0                            | (6a)         |
| Number of open flues<br>Number of intermittent far                                    |   | 0                 |           | 0                |                | 0           |                       | 0 =<br>10 =  | 0                            | (6b)<br>(7a) |
| Number of passive vents   |   |                   |           |                  |                | 0           |                       | 0 =          | 0                            | (7a)         |
| Number of flueless gas fir  | es  |                   |           |                  |                | 0           |                       | 40 =         | 0                            | (70)         |
|   |   |                   |           |                  | L              | 0           |                       | Air ch       | anges per ho                 |              |
| Infiltration due to chimney   |   |                   |           |                  |                | 0           |                       | ÷ (5) =      | 0                            | (8)          |
| If a pressurisation test has be<br>Number of storeys in th<br>Additional infiltration | e dwelling (ns)   |                   |           |                  |                |             |                       | 1]x0.1 =     | 0                            | (9)<br>(10)  |
| deducting areas of opening  | esent, use the value corresp<br>gs); if equal user 0.35 | oonding to th     | he greate | er wall area     | a (after       | uction      |                       |              | 0                            | (11)         |
| If suspended wooden fl  |   | ed) or 0.1        | (seale    | d), else         | enter 0        |             |                       |              | 0                            | (12)         |
| If no draught lobby, ent  |   |                   |           |                  |                |             |                       |              | 0                            | (13)         |
| Percentage of windows<br>Window infiltration  | and doors draught str                                   | прреа             | (         | 0.25 - [0.2      | x (14) ÷ 1     | 001 -       |                       |              | 0                            | (14)         |
| Infiltration rate   |   |                   |           | (8) + (10) -     |                |             | + (15) =              |              | 0                            | (15)<br>(16) |
| Air permeability value, o   | a50. expressed in cubi                                  | ic metres         |           |                  |                |             |                       | area         | 2                            | (17)         |
| If based on air permeabilit   |   |                   | •         | •                | •              |             |                       |              | 0.1                          | (18)         |
| Air permeability value applies  | -   |                   |           |                  |                | is being us | sed                   | I            | -                            |              |
| Number of sides sheltered   | b   |                   |           |                  |                |             |                       |              | 1                            | (19)         |
| Shelter factor  |   |                   |           | (20) = 1 - [     |                | 9)] =       |                       |              | 0.92                         | (20)         |
| Infiltration rate incorporati   | -   |                   | (         | (21) = (18)      | x (20) =       |             |                       |              | 0.09                         | (21)         |
| Infiltration rate modified for  |   | 1                 |           |                  |                | _           |                       |              |                              |              |
| Jan Feb   | Mar Apr May   | Jun               | Jul       | Aug              | Sep            | Oct         | Nov                   | Dec          |                              |              |
| Monthly average wind spe  |   |                   |           | I                |                |             |                       | <b>1</b>     |                              |              |
| (22)m= 5.1 5  | 4.9 4.4 4.3   | 3.8               | 3.8       | 3.7              | 4              | 4.3         | 4.5                   | 4.7          |                              |              |
| Wind Factor (22a)m = (22  | · · · · ·   |                   | ,         |                  |                |             | 1                     |              |                              |              |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08  | 0.95              | 0.95      | 0.92             | 1              | 1.08        | 1.12                  | 1.18         |                              |              |

| Adjuste   | ed infiltr             | ation rat                      | e (allow       | ing for sh                  | nelter an    | d wind s        | peed) =         | (21a) x                               | (22a)m       |               |                       |                    |                  |               |
|-----------|------------------------|--------------------------------|----------------|-----------------------------|--------------|-----------------|-----------------|---------------------------------------|--------------|---------------|-----------------------|--------------------|------------------|---------------|
|           | 0.12                   | 0.12                           | 0.11           | 0.1                         | 0.1          | 0.09            | 0.09            | 0.09                                  | 0.09         | 0.1           | 0.1                   | 0.11               | ]                |               |
|           |                        | <i>ctive air</i><br>al ventila | -              | rate for t                  | he appli     | cable ca        | se              |                                       |              |               |                       |                    |                  | (23a)         |
|           |                        |                                |                | endix N, (2                 | (23a) = (23a | a) x Fmv (e     | equation (I     | N5)), othe                            | rwise (23b   | (23a) = (23a) |                       |                    | 0.5              |               |
|           |                        |                                |                | ciency in %                 |              |                 |                 |                                       |              | <i>(</i> 200) |                       |                    | 0.5              | (23b)         |
|           |                        |                                | -              | -                           | -            |                 |                 |                                       |              | 2b)m + (2     | 23h) v [ <sup>,</sup> | 1 _ (23c)          | 73.1<br>÷ 1001   | (23c)         |
| (24a)m=   | 0.25                   | 0.25                           | 0.25           | 0.24                        | 0.23         | 0.22            | 0.22            | 0.22                                  | 0.23         | 0.23          | 0.24                  | 0.24               | ]                | (24a)         |
|           |                        |                                |                |                             |              |                 |                 |                                       |              | 2b)m + (2     | -                     | •                  | ]                | · · ·         |
| (24b)m=   | 0                      |                                |                | 0                           | 0            | 0               |                 |                                       | 0            | 0             | 0                     | 0                  | ן                | (24b)         |
|           | u<br>whole h           | I<br>Iouse ex                  | I<br>tract ver | ntilation of                | r positiv    | l<br>ve input v | l<br>ventilatio | n from o                              | L<br>outside |               |                       |                    | J                |               |
| ,         |                        |                                |                |                             | •            | •               |                 |                                       |              | .5 × (23b     | )                     |                    |                  |               |
| (24c)m=   | 0                      | 0                              | 0              | 0                           | 0            | 0               | 0               | 0                                     | 0            | 0             | 0                     | 0                  |                  | (24c)         |
| ,         |                        |                                |                | ole hous                    | •            |                 |                 |                                       |              | -             |                       | -                  | -                |               |
| 1         | · ,                    | r                              | r í j          | )m = (22l                   | ŕ            | r Ì             | ,<br>           | 1                                     | r            |               |                       | -                  | 1                |               |
| (24d)m=   |                        | 0                              | 0              | 0                           | 0            | 0               | 0               | 0                                     | 0            | 0             | 0                     | 0                  |                  | (24d)         |
| 1         |                        | <u> </u>                       |                | nter (24a                   | , <u>,</u>   | <u> </u>        | , <u>,</u>      | · · · · · · · · · · · · · · · · · · · | <u> </u>     |               |                       | i                  | 1                | ( )           |
| (25)m=    | 0.25                   | 0.25                           | 0.25           | 0.24                        | 0.23         | 0.22            | 0.22            | 0.22                                  | 0.23         | 0.23          | 0.24                  | 0.24               |                  | (25)          |
| 3. He     | at l <mark>osse</mark> | s and he                       | eat loss       | paramete                    | er:          |                 |                 |                                       |              |               |                       |                    |                  |               |
| ELEN      |                        | Gros<br>are <mark>a</mark>     |                | Openin<br>m                 |              | Net Ar<br>A ,r  |                 | U-val<br>W/m2                         |              | A X U<br>(W/ł | <)                    | k-value<br>kJ/m²·l |                  | A X k<br>kJ/K |
| Windov    | ws Type                | e 1                            |                |                             |              | 2.7             | x1/             | /[1/( 0.73 )-                         | + 0.04] =    | 1.92          |                       |                    |                  | (27)          |
| Windov    | ws Type                | 92                             |                |                             |              | 3.6             | x1/             | /[1/( 0.73 )-                         | + 0.04] =    | 2.55          |                       |                    |                  | (27)          |
| Windov    | ws Type                | e 3                            |                |                             |              | 7.2             | ×1/             | /[1/( 0.73 )-                         | + 0.04] =    | 5.11          | F.                    |                    |                  | (27)          |
| Window    | ws Type                | e 4                            |                |                             |              | 4.94            | x1/             | /[1/( 0.73 )-                         | + 0.04] =    | 3.5           | 5                     |                    |                  | (27)          |
| Walls 1   | Гуре1                  | 5                              |                | 2.7                         |              | 2.3             | x               | 0.15                                  | =            | 0.35          |                       |                    |                  | (29)          |
| Walls 7   | Гуре2                  | 31.                            | 5              | 3.6                         |              | 27.9            | x               | 0.15                                  | = [          | 4.19          | ז ד                   |                    | $\exists \vdash$ | (29)          |
| Walls 7   | ГуреЗ                  | 22.7                           | 75             | 7.2                         |              | 15.55           | 5 X             | 0.15                                  |              | 2.33          | ז ד                   |                    | $\exists \vdash$ | (29)          |
| Walls 7   | Гуре4                  | 15                             | ;              | 4.94                        |              | 10.06           | 3 X             | 0.15                                  | =            | 1.51          | ז ר                   |                    | = =              | (29)          |
| Total a   | rea of e               | elements                       | , m²           |                             |              | 74.25           | 5               | μ                                     |              |               |                       |                    |                  | (31)          |
| Party v   | vall                   |                                |                |                             |              | 37.5            | x               | 0                                     | =            | 0             |                       |                    |                  | (32)          |
| Party f   | loor                   |                                |                |                             |              | 76.8            |                 |                                       | I            |               | L                     |                    | $\dashv$         | (32a)         |
| Party c   | eiling                 |                                |                |                             |              | 76.8            |                 |                                       |              |               | L<br>L                |                    | $\dashv$         | (32b)         |
| -         | ul wall **             |                                |                |                             |              | 117             |                 |                                       |              |               | L<br>L                |                    | $\dashv$         | (32c)         |
| * for win | dows and               | l roof wind                    |                | effective wi<br>nternal wal |              | alue calcul     | ated using      | g formula 1                           | !/[(1/U-valı | ıe)+0.04] a   | L<br>s given in       | paragraph          | L<br>1 3.2       | (1 - 7        |
|           |                        | ss, W/K :                      |                |                             |              |                 |                 | (26)(30)                              | ) + (32) =   |               |                       |                    | 21.45            | (33)          |
|           |                        | Cm = S(                        | •              | -                           |              |                 |                 |                                       | ((28)        | (30) + (32    | 2) + (32a).           | (32e) =            | 16870.           |               |

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

250

Indicative Value: Medium

(35)

|           |                       | 00          | are not kr  | nown (36) =                | = 0.05 x (3      | :1)                                    |            |                 |              |                           |                        |         | -       | _            |
|-----------|-----------------------|-------------|-------------|----------------------------|------------------|--|------------|-----------------|--------------|---------------------------|------------------------|---------|---------|--------------|
| Total     | fabric he             | at loss     |             |                            |                  |  |            |                 | (33) +       | (36) =                    |                        |         | 29.44   | (37)         |
| Ventila   | ation hea             | at loss c   | alculated   | d monthly                  | y                |  |            |                 | (38)m        | = 0.33 × (                | (25)m x (5)            | )       |         |              |
|           | Jan                   | Feb         | Mar         | Apr                        | May              | Jun                                    | Jul        | Aug             | Sep          | Oct                       | Nov                    | Dec     |         |              |
| (38)m=    | 15.99                 | 15.85       | 15.7        | 14.97                      | 14.82            | 14.09                                  | 14.09      | 13.94           | 14.38        | 14.82                     | 15.12                  | 15.41   |         | (38)         |
| Heat t    | ransfer o             | coefficie   | nt, W/K     |                            |                  |  |            |                 | (39)m        | = (37) + (                | 38)m                   |         |         |              |
| (39)m=    | 45.44                 | 45.29       | 45.15       | 44.41                      | 44.27            | 43.53                                  | 43.53      | 43.39           | 43.83        | 44.27                     | 44.56                  | 44.85   |         |              |
|           |                       |             | •           |                            |                  | •                                      | •          |                 |              | Average =                 | Sum(39)1               | 12 /12= | 44.38   | (39)         |
|           | oss para              | ameter (H   | HLP), W     | /m²K                       | r                | i                                      | i          |                 | (40)m        | = (39)m ÷                 | · (4)                  |         | 1       |              |
| (40)m=    | 0.59                  | 0.59        | 0.59        | 0.58                       | 0.58             | 0.57                                   | 0.57       | 0.56            | 0.57         | 0.58                      | 0.58                   | 0.58    |         | <b>-</b>     |
| Numb      | er of day             | ys in mo    | nth (Tab    | le 1a)                     | -                | -                                      | -          | -               |              | Average =                 | Sum(40)₁               | 12 /12= | 0.58    | (40)         |
|           | Jan                   | Feb         | Mar         | Apr                        | May              | Jun                                    | Jul        | Aug             | Sep          | Oct                       | Nov                    | Dec     |         |              |
| (41)m=    | 31                    | 28          | 31          | 30                         | 31               | 30                                     | 31         | 31              | 30           | 31                        | 30                     | 31      | ]       | (41)         |
|           |                       |             | -           |                            |                  | -                                      | -          |                 |              | -                         | -                      |         | -       |              |
| 4. W      | ater hea              | ting ene    | rav requ    | irement:                   |                  |  |            |                 |              |                           |                        | kWh/ye  | ear:    |              |
|           |                       | Ŭ           |             |                            |                  |  |            |                 |              |                           |                        |         | 1       |              |
|           | ned occι<br>=∆        |             |             | / [1 - evo                 | (_0 0003         |  | -130       | )2)] + 0.0      | 1013 v (     | TFA -13                   |                        | 2.4     |         | (42)         |
|           | -A £ 13.              |             | + 1.707     | ιι-exp                     | (-0.0000         | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | A-10.9     | ()2)] + 0.0     | ) / 10/0     | 11 A - 13.                | .3)                    |         |         |              |
|           |                       |             |             |                            |                  |  |            | (25 x N)        |              |                           |                        | .18     |         | (43)         |
|           |                       | -           |             | usage by a<br>r day (all w |                  | -                                      | -          | to achieve      | a water us   | se target o               | ť                      |         |         |              |
| not moi   |                       |             |             |                            |                  |  |            |                 |              |                           |                        | 1       | 1       |              |
| Hot way   | Jan                   | Feb         | Mar<br>Mar  | Apr<br>ach month           | May<br>Vd m - fa | Jun                                    | Jul        | Aug             | Sep          | Oct                       | Nov                    | Dec     |         |              |
|           | _                     |             |             |                            |                  |  |            | -               |              |                           |                        |         | 1       |              |
| (44)m=    | 100.3                 | 96.66       | 93.01       | 89.36                      | 85.71            | 82.07                                  | 82.07      | 85.71           | 89.36        | 93.01                     | 96.66                  | 100.3   |         |              |
| Energy    | content of            | f hot water | used - ca   | lculated mo                | onthly $= 4$ .   | 190 x Vd,r                             | m x nm x L | OTm / 3600      |              | Total = Su<br>hth (see Ta |                        |         | 1094.21 | (44)         |
| (45)m=    | 148.75                | 130.09      | 134.25      | 117.04                     | 112.3            | 96.91                                  | 89.8       | 103.05          | 104.28       | 121.52                    | 132.65                 | 144.05  |         |              |
|           |                       |             |             |                            |                  |  |            |                 |              | Total = Su                | m(45) <sub>112</sub> = | =       | 1434.68 | (45)         |
| lf instar | ntaneous v            | vater heati | ng at point | t of use (no               | o hot water      | r storage),                            | enter 0 in | boxes (46       | ) to (61)    |                           |                        |         | 1       |              |
| (46)m=    |                       | 19.51       | 20.14       | 17.56                      | 16.85            | 14.54                                  | 13.47      | 15.46           | 15.64        | 18.23                     | 19.9                   | 21.61   |         | (46)         |
|           | storage               |             | ) includir  | na anv so                  | olar or M        | WHRS                                   | storage    | within sa       | ame ves      | مما                       |                        | 0       | 1       | (47)         |
|           | -                     | . ,         |             | ank in dw                  |                  |  | -          |                 |              | 001                       |                        | 0       | J       | (47)         |
|           | •                     | •           |             |                            | •                |  |            | ombi boil       | ers) ente    | er '0' in (               | 47)                    |         |         |              |
|           | storage               |             |             |                            |                  |  |            |                 |              |                           | ,,                     |         |         |              |
| a) If r   | nanufac               | turer's de  | eclared l   | oss facto                  | or is kno        | wn (kWł                                | n/day):    |                 |              |                           |                        | 0       | ]       | (48)         |
| Temp      | erature f             | actor fro   | m Table     | 2b                         |                  |  |            |                 |              |                           |                        | 0       |         | (49)         |
| Energ     | y lost fro            | om watei    | · storage   | e, kWh/ye                  | ear              |  |            | (48) x (49) = 0 |              |                           |                        |         | ĺ       | (50)         |
|           |                       |             |             | cylinder l                 |                  |  |            |                 |              |                           |                        |         |         |              |
|           |                       | -           |             | rom Tabl                   | e 2 (kW          | h/litre/da                             | ay)        |                 |              |                           |                        | 0       |         | (51)         |
|           | munity h<br>ne factor | -           |             | on 4.3                     |                  |  |            |                 |              |                           |                        |         | 1       |              |
|           | erature f             |             |             | 2b                         |                  |  |            |                 |              |                           |                        | 0       |         | (52)<br>(53) |
|           |                       |             |             | , kWh/ye                   | oor              |  |            | (47) x (51)     | V (50) v (   | 53) -                     |                        |         | ]       |              |
| -         | (50) or               |             | -           | , i.vvi // yt              | 501              |  |            | (۱۵) ۸ (۱۰      | , ~ (0~) ^ ( |                           |                        | 0       |         | (54)<br>(55) |
|           | ·/-·                  | , ,         | .,          |                            |                  |  |            |                 |              |                           |                        | ~       | J       | ()           |

| Water      | storage     | loss cal                              | culated     | for each                                      | month      |                                       |             | ((56)m = (                            | 55) × (41)   | m           |             |             |               |      |
|------------|-------------|---------------------------------------|-------------|---|------------|---------------------------------------|-------------|---------------------------------------|--------------|-------------|-------------|-------------|---------------|------|
| (56)m=     | 0           | 0                                     | 0           | 0   | 0          | 0                                     | 0           | 0                                     | 0            | 0           | 0           | 0           |               | (56) |
| If cylinde | er contains | s dedicate                            | d solar sto | orage, (57)                                   | m = (56)m  | x [(50) – (                           | H11)] ÷ (5  | 0), else (5                           | 7)m = (56)   | m where (   | H11) is fro | m Append    | lix H         |      |
| (57)m=     | 0           | 0                                     | 0           | 0   | 0          | 0                                     | 0           | 0                                     | 0            | 0           | 0           | 0           |               | (57) |
| Primar     | y circuit   | loss (ar                              | nnual) fro  | om Table                                      | e 3        | -                                     |             |                                       |              | -           |             | 0           |               | (58) |
|            | •           | •                                     | ,           | for each                                      |            | 59)m = (                              | (58) ÷ 36   | 65 × (41)                             | m            |             |             |             |               |      |
| (mo        | dified by   | factor f                              | rom Tab     | le H5 if t                                    | here is s  | solar wat                             | er heatii   | ng and a                              | cylinde      | r thermo    | stat)       |             |               |      |
| (59)m=     | 0           | 0                                     | 0           | 0   | 0          | 0                                     | 0           | 0                                     | 0            | 0           | 0           | 0           |               | (59) |
| Combi      | loss ca     | lculated                              | for each    | n month (                                     | (61)m =    | (60) ÷ 36                             | 65 × (41)   | )m                                    |              |             |             |             |               |      |
| (61)m=     | 11.84       | 10.68                                 | 11.8        | 11.4  | 11.76      | 11.36                                 | 11.73       | 11.75                                 | 11.38        | 11.79       | 11.43       | 11.83       |               | (61) |
| Total h    | neat requ   | uired for                             | water h     | eating ca                                     | alculated  | for eac                               | h month     | (62)m =                               | 0.85 × (     | (45)m +     | (46)m +     | (57)m +     | (59)m + (61)m | ו    |
| (62)m=     | 160.59      | 140.77                                | 146.05      | 128.44  | 124.06     | 108.27                                | 101.53      | 114.79                                | 115.66       | 133.31      | 144.09      | 155.88      |               | (62) |
| Solar DI   | -IW input o | calculated                            | using App   | endix G o                                     | r Appendix | H (negati                             | ve quantity | /) (enter '0                          | ' if no sola | r contribut | ion to wate | er heating) |               |      |
| (add a     | dditiona    | l lines if                            | FGHRS       | and/or \                                      | WHRS       | applies                               | , see Ap    | pendix (                              | G)           | i           | i           | i           | 1             |      |
| (63)m=     | 0           | 0                                     | 0           | 0   | 0          | 0                                     | 0           | 0                                     | 0            | 0           | 0           | 0           |               | (63) |
| Output     | t from w    | ater hea                              | ter         | r   | 1          |                                       | r           |                                       |              |             |             |             | 1             |      |
| (64)m=     | 160.59      | 140.77                                | 146.05      | 128.44  | 124.06     | 108.27                                | 101.53      | 114.79                                | 115.66       | 133.31      | 144.09      | 155.88      |               | -    |
|            |             |                                       |             |   |            |                                       |             |                                       |              |             | r (annual)₁ |             | 1573.43       | (64) |
|            |             |                                       |             | , kWh/m                                       |            |                                       |             |                                       | -            |             | 1           | - · ·       | ]             |      |
| (65)m=     | 52.42       | 45.93                                 | 47.59       | 41.76   | 40.28      | 35.06                                 | 32.79       | 37.2                                  | 37.52        | 43.35       | 46.97       | 50.86       |               | (65) |
| inclu      | ide (57)    | m in calo                             | culation    | of (65)m                                      | only if c  | ylinder i                             | s in the o  | dwelling                              | or hot w     | ater is fr  | om com      | munity h    | eating        |      |
| 5. Int     | ternal ga   | ains (see                             | e Table {   | 5 and 5a                                      | ):         |                                       |             |                                       |              |             |             |             |               |      |
| Metab      | olic gain   | s (Table                              |             | tts   |            |                                       |             | i                                     |              |             |             |             |               |      |
|            | Jan         | Feb                                   | Mar         | Apr   | May        | Jun                                   | Jul         | Aug                                   | Sep          | Oct         | Nov         | Dec         |               | ()   |
| (66)m=     | 119.97      | 119.97                                | 119.97      | 119.97  | 119.97     | 119.97                                | 119.97      | 119.97                                | 119.97       | 119.97      | 119.97      | 119.97      |               | (66) |
| •          | <u> </u>    |                                       |             | ppendix                                       |            |                                       | , ·         | · · · · · · · · · · · · · · · · · · · |              |             |             | r           | 1             | ()   |
|            |             |                                       |             | 14.21   |            |                                       |             | 12.6                                  | 16.91        | 21.47       | 25.06       | 26.72       |               | (67) |
|            |             | · · · · · · · · · · · · · · · · · · · | 1           | n Append                                      | · · · ·    |                                       |             | ,<br>                                 |              | 1           |             | i           | 1             | ()   |
| (68)m=     |             | 214.83                                | 209.27      | 197.43  | 182.49     | 168.45                                | 159.07      | 156.86                                | 162.42       | 174.26      | 189.2       | 203.24      |               | (68) |
|            | <u> </u>    | · · · · · · · · · · · · · · · · · · · | r           | ppendix                                       | · · ·      |                                       | ,<br>I      | 1                                     | 1            | r           |             |             | 1             | ()   |
| (69)m=     | 35          | 35                                    | 35          | 35  | 35         | 35                                    | 35          | 35                                    | 35           | 35          | 35          | 35          |               | (69) |
| •          | r           | ns gains                              | r <u>`</u>  | <u>,                                     </u> |            |                                       | r           | r                                     | r            | 1           | 1           | r           | 1             |      |
| (70)m=     | 3           | 3                                     | 3           | 3   | 3          | 3                                     | 3           | 3                                     | 3            | 3           | 3           | 3           |               | (70) |
| Losses     | <u> </u>    | · · · · · · · · · · · · · · · · · · · | · · ·       | tive valu                                     | es) (Tab   | · · · · · · · · · · · · · · · · · · · | i           | i                                     | i            | i           | i           | i           | 1             |      |
| (71)m=     | -95.97      | -95.97                                | -95.97      | -95.97  | -95.97     | -95.97                                | -95.97      | -95.97                                | -95.97       | -95.97      | -95.97      | -95.97      |               | (71) |
| Water      | <u> </u>    | gains (T                              | able 5)     |   |            |                                       |             |                                       |              | 1           | 1           |             | 1             |      |
| (72)m=     | 70.45       | 68.34                                 | 63.96       | 58.01   | 54.14      | 48.7                                  | 44.07       | 50                                    | 52.11        | 58.27       | 65.23       | 68.35       |               | (72) |
| Total i    | r           | gains =                               |             |   |            | (66)                                  | m + (67)m   | n + (68)m +                           | + (69)m +    | (70)m + (7  | 1)m + (72)  | m           | 1             |      |
| (73)m=     | 371.06      | 368.25                                | 354         | 331.64  | 309.25     | 288.11                                | 274.82      | 281.45                                | 293.43       | 315.99      | 341.48      | 360.3       |               | (73) |
|            |             |                                       |             |   |            |                                       |             |                                       |              |             |             |             |               |      |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: Access Factor<br>Table 6d |   | Area<br>m² |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x 0.77                    | x | 3.6        | x | 11.28            | x | 0.63           | x | 0.1            | = | 1.77         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 22.97            | x | 0.63           | x | 0.1            | = | 3.61         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 41.38            | x | 0.63           | x | 0.1            | = | 6.5          | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 67.96            | x | 0.63           | x | 0.1            | = | 10.68        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 91.35            | x | 0.63           | x | 0.1            | = | 14.36        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 97.38            | x | 0.63           | x | 0.1            | = | 15.31        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 91.1             | x | 0.63           | x | 0.1            | = | 14.32        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 72.63            | x | 0.63           | x | 0.1            | = | 11.41        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 50.42            | x | 0.63           | x | 0.1            | = | 7.92         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 28.07            | x | 0.63           | x | 0.1            | = | 4.41         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 14.2             | x | 0.63           | x | 0.1            | = | 2.23         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 9.21             | x | 0.63           | x | 0.1            | = | 1.45         | (75) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 36.79            |   | 0.63           | x | 0.1            | = | 4.34         | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 62.67            |   | 0.63           | x | 0.1            | = | 7.39         | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 85.75            |   | 0.63           | x | 0.1            | = | 10.11        | (79) |
| Southwest0.9x 0.77                     | x | 2.7        | × | 106.25           |   | 0.63           | х | 0.1            | = | 12.52        | (79) |
| Southwest <mark>0.9x</mark> 0.77       | x | 2.7        | x | 119.01           |   | 0.63           | x | 0.1            | = | 14.03        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 118.15           |   | 0.63           | x | 0.1            | = | 13.93        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 113.91           |   | 0.63           | x | 0.1            | = | 13.43        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 104.39           |   | 0.63           | x | 0.1            | = | 12.31        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 92.85            |   | 0.63           | x | 0.1            | = | 10.95        | (79) |
| Southwest0.9x 0.77                     | x | 2.7        | x | 69.27            |   | 0.63           | x | 0.1            | = | 8.17         | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 44.07            |   | 0.63           | x | 0.1            | = | 5.2          | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 31.49            |   | 0.63           | x | 0.1            | = | 3.71         | (79) |
| West 0.9x 0.77                         | x | 4.94       | x | 19.64            | x | 0.63           | x | 0.1            | = | 4.24         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 38.42            | x | 0.63           | x | 0.1            | = | 8.29         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 63.27            | x | 0.63           | x | 0.1            | = | 13.65        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 92.28            | x | 0.63           | x | 0.1            | = | 19.9         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 113.09           | x | 0.63           | x | 0.1            | = | 24.39        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 115.77           | x | 0.63           | x | 0.1            | = | 24.97        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 110.22           | x | 0.63           | x | 0.1            | = | 23.77        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 94.68            | x | 0.63           | x | 0.1            | = | 20.42        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 73.59            | x | 0.63           | x | 0.1            | = | 15.87        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 45.59            | x | 0.63           | x | 0.1            | = | 9.83         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 24.49            | x | 0.63           | x | 0.1            | = | 5.28         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 16.15            | x | 0.63           | x | 0.1            | = | 3.48         | (80) |
| Northwest 0.9x 0.77                    | x | 7.2        | x | 11.28            | x | 0.63           | x | 0.1            | = | 3.55         | (81) |
| Northwest 0.9x 0.77                    | x | 7.2        | x | 22.97            | x | 0.63           | x | 0.1            | = | 7.22         | (81) |
| Northwest 0.9x 0.77                    | x | 7.2        | x | 41.38            | x | 0.63           | x | 0.1            | = | 13.01        | (81) |

| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | 6              | 7.96      | ×           | 0.63         | ×   | 0.1         | =                   | 21.36 | (81) |
|--|----------|-------------------|----------|----------------|-----------|-------------|--------------|---|-------------|---------------------|-------|------|
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | 9              | 1.35      | x           | 0.63         | ×   | 0.1         | =                   | 28.71 | (81) |
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | 9              | 7.38      | x           | 0.63         | x   | 0.1         | =                   | 30.61 | (81) |
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | ę              | 91.1      | <b>x</b>    | 0.63         | ×   | 0.1         | =                   | 28.64 | (81) |
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | 7              | 2.63      | x           | 0.63         | x   | 0.1         | =                   | 22.83 | (81) |
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | 5              | 0.42      | x           | 0.63         | x   | 0.1         | =                   | 15.85 | (81) |
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | 2              | 8.07      | <b>x</b> [  | 0.63         | ×   | 0.1         | =                   | 8.82  | (81) |
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | ·              | 14.2      | ) × [       | 0.63         | x   | 0.1         | =                   | 4.46  | (81) |
| Northwest 0.9x 0.77                                      | x        | 7.2               | x        | 9              | 9.21      | x           | 0.63         | x   | 0.1         | =                   | 2.9   | (81) |
|  |          |                   |          |                |           |             |              |   |             |                     |       |      |
| Solar gains in watts, calcula                            | ated     | for each mont     | h        |                |           | (83)m       | = Sum(74)m . | (82)m   |             |                     |       |      |
| (83)m= 13.89 26.5 43.2                                   |          | 64.47 81.49       |          | 84.81          | 80.15     | 66.9        | 97 50.59     | 31.23   | 17.17       | 11.54               |       | (83) |
| Total gains – internal and s                             | olar     | (84)m = (73)m     | ) + (    | 83)m           | , watts   |             |              |   | -i          |                     |       |      |
| (84)m= 384.95 394.75 397.                                | 26       | 396.11 390.74     | 3        | 72.92          | 354.98    | 348.        | 42 344.02    | 347.22  | 358.65      | 371.84              |       | (84) |
| 7. Mean internal temperate                               | ure (    | (heating seaso    | n)       |                |           |             |              |   |             |                     |       |      |
| Temperature during heatir                                | ng pe    | eriods in the liv | ving     | area f         | from Tab  | ole 9,      | Th1 (°C)     |   |             |                     | 21    | (85) |
| Utilisation factor for gains                             | for li   | iving area, h1,i  | n (s     | ee Ta          | ble 9a)   |             |              |   |             |                     |       |      |
| Jan Feb M  | ar       | Apr May           | ,        | Jun            | Jul       | Αι          | ug Sep       | Oct   | Nov         | Dec                 |       |      |
| (86)m= 1 1 1   |          | 0.98 0.92         |          | 0.73           | 0.54      | 0.5         | 7 0.83       | 0.98  | 1           | 1                   |       | (86) |
| Mean internal temperature                                | e in li  | iving area T1     | follc    | ow ste         | ps 3 to 7 | ,<br>7 in T | able 9c)     |   |             |                     |       |      |
| (87)m= 20.49 20.54 20.0                                  | -        | 20.8 20.93        | _        | 20.99          | 21        | 21          | <u> </u>     | 20.84   | 20.64       | 2 <mark>0.48</mark> |       | (87) |
| Temperature during heatir                                |          | ariode in rest o  | f du     | volling        | from To   | blo 0       | Th2 (PC)     |   | 1           |                     |       |      |
| (88)m = 20.44 20.44 20.44                                |          | 20.45 20.45       |          | 20.46          | 20.46     | 20.4        |              | 20.45   | 20.45       | 20.44               |       | (88) |
|  |          |                   | _        |                |           |             |              |   |             | -                   |       |      |
| Utilisation factor for gains                             | -        | 0.98 0.9          | <u> </u> | ,m (se<br>0.68 | 0.47      | 9a)<br>0.5  | 1 0.78       | 0.97  |             | 4                   |       | (89) |
|  |          |                   |          |                |           |             |              |   | 1           | 1                   |       | (03) |
| Mean internal temperature                                | -        |                   |          |                |           | r <u> </u>  |              | <u>,                                     </u> |             |                     | I     |      |
| (90)m= 19.74 19.82 19.9                                  | 97       | 20.2 20.38        |          | 20.45          | 20.46     | 20.4        |              | 20.25   | 19.97       | 19.73               |       | (90) |
|  |          |                   |          |                |           |             | 1            | tla = Livi                                    | ng area ÷ ( | 4) =                | 0.34  | (91) |
| Mean internal temperature                                | e (for   | r the whole dw    | ellin    | ig) = fl       | _A × T1   | + (1 -      | – fLA) × T2  |   | _           |                     |       |      |
| (92)m= 20 20.07 20.                                      | 2        | 20.4 20.57        | 2        | 20.64          | 20.64     | 20.6        | 65 20.62     | 20.45   | 20.2        | 19.99               |       | (92) |
| Apply adjustment to the m                                | ean      | ·                 | eratu    | ure fro        | m Table   | 4e, \       | where appro  | opriate                                       |             |                     | I     |      |
| (93)m= 19.85 19.92 20.0                                  |          | 20.25 20.42       |          | 20.49          | 20.49     | 20.         | 5 20.47      | 20.3  | 20.05       | 19.84               |       | (93) |
| 8. Space heating requirem                                |          |                   |          |                |           |             |              |   |             |                     |       |      |
| Set Ti to the mean interna the utilisation factor for ga |          | •                 | inec     | d at ste       | ep 11 of  | Table       | e 9b, so tha | at Ti,m=                                      | (76)m an    | d re-calc           | ulate |      |
|  | ar       | Apr May           | ,        | Jun            | Jul       | Αι          | ıg Sep       | Oct   | Nov         | Dec                 |       |      |
| Utilisation factor for gains,                            |          |                   |          | Jun            | 501       |             | ig Dep       |   |             | Dec                 |       |      |
| (94)m= 1 1 0.9   | -        | 0.97 0.89         | Т        | 0.68           | 0.48      | 0.5         | 1 0.79       | 0.97  | 0.99        | 1                   |       | (94) |
| Useful gains, hmGm , W =                                 | : (94    |                   |          |                |           |             |              | <u> </u>                                      |             |                     |       |      |
| (95)m= 384.13 393.4 394.                                 | <u> </u> | 385.5 349.53      | 2        | 53.73          | 169.44    | 177.        | 52 270.38    | 336.17  | 356.74      | 371.23              |       | (95) |
| Monthly average external                                 | temp     | perature from     | Tab      | le 8           | L         | 1           | <b>I</b>     | I   |             |                     | I     |      |
| (96)m= 4.3 4.9 6.5                                       | 5        | 8.9 11.7          |          | 14.6           | 16.6      | 16.         | 4 14.1       | 10.6  | 7.1         | 4.2                 |       | (96) |
| Heat loss rate for mean in                               | terna    | al temperature    | , Ln     | ר, W =         | =[(39)m : | x [(93      | 3)m– (96)m   | ]   |             |                     |       |      |
| (97)m= 706.48 680.2 611.                                 | 88       | 504.2 385.84      | 2        | 56.37          | 169.55    | 177.        | 69 279.34    | 429.51  | 577.14      | 701.36              |       | (97) |
|  |          |                   |          |                |           |             |              |   |             |                     |       |      |

| Space   | e heatin  | g require         | ement fo           | r each n       | nonth, k  | Wh/mon    | th = 0.02 | 24 x [(97) | )m – (95        | )m] x (4 <sup>-</sup> | 1)m                        |            |         |       |
|---|-----------|-------------------|--------------------|----------------|-----------|-----------|-----------|------------|-----------------|-----------------------|----------------------------|------------|---------|-------|
| (98)m=  | 239.83    | 192.73            | 161.95             | 85.47          | 27.01     | 0         | 0         | 0          | 0               | 69.44                 | 158.69                     | 245.62     |         |       |
|   |           |                   |                    |                |           |           |           | Tota       | l per year      | (kWh/year             | r) = Sum(9                 | 8)15,912 = | 1180.74 | (98)  |
| Space   | e heatin  | g require         | ement in           | kWh/m²         | ²/year    |           |           |            |                 |                       |                            |            | 15.37   | (99)  |
| 9a. Ene   | ergy rec  | luiremer          | nts – Ind          | ividual h      | eating s  | ystems i  | ncluding  | micro-C    | CHP)            |                       |                            |            |         |       |
| -   | e heatir  | -                 |                    |                |           |           |           |            |                 |                       |                            |            |         | _     |
|   |           |                   |                    |                |           | ementary  | -         |            |                 |                       |                            |            | 0       | (201) |
| Fraction of space heat from main system(s) $(202) = 1 - (201) =$                  |           |                   |                    |                |           |           |           | 1          | (202)           |                       |                            |            |         |       |
| Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$ |           |                   |                    |                |           |           |           |            | 1               | (204)                 |                            |            |         |       |
| Efficiency of main space heating system 1   |           |                   |                    |                |           |           |           |            | 89.9            | (206)                 |                            |            |         |       |
| Efficie   | ncy of s  | seconda           | ry/suppl           | ementar        | y heatin  | g system  | ı, %      |            |                 |                       |                            |            | 0       | (208) |
|   | Jan       | Feb               | Mar                | Apr            | May       | Jun       | Jul       | Aug        | Sep             | Oct                   | Nov                        | Dec        | kWh/ye  | ar    |
| Space   |           |                   | · · · ·            | alculate       | 1         | 1         |           |            |                 |                       |                            |            |         |       |
|   | 239.83    | 192.73            | 161.95             | 85.47          | 27.01     | 0         | 0         | 0          | 0               | 69.44                 | 158.69                     | 245.62     |         |       |
| (211)m<br>ז   |           |                   | r                  | 00 ÷ (20       | r         |           |           |            |                 |                       |                            |            |         | (211) |
| L   | 266.78    | 214.38            | 180.15             | 95.07          | 30.05     | 0         | 0         |            | 0<br>I (kWh/yea | 77.25                 | 176.52                     | 273.21     | 1010.00 | (011) |
| Cross   | k e e tim | n fuel (a         | a na mala m        |                | no o n th |           |           | TULA       | ii (KVVII/yee   |                       | - · · / <sub>15,1012</sub> |            | 1313.39 | (211) |
| •   |           |                   | 00 ÷ (20           | y), kWh/<br>8) | month     |           |           |            |                 |                       |                            |            |         |       |
| (215)m=   | 0         | 0                 | 0                  | 0              | 0         | 0         | 0         | 0          | 0               | 0                     | 0                          | 0          |         |       |
| Ľ   |           |                   |                    |                |           | r         |           | Tota       | l (kWh/yea      | ar) =Sum(2            | 215) <sub>15,1012</sub>    | =          | 0       | (215) |
| Wat <mark>er</mark>   | heating   |                   |                    |                |           |           |           |            |                 |                       |                            |            |         |       |
| Out <mark>put</mark>  |           |                   |                    | ulated al      |           |           |           |            |                 |                       |                            |            |         |       |
|   | 160.59    | 140.77            | 146.05             | 128.44         | 124.06    | 108.27    | 101.53    | 114.79     | 115.66          | 13 <mark>3.31</mark>  | 144.09                     | 155.88     |         |       |
| г   |           | ater hea<br>88.52 |                    | 07.05          | 07.00     | 00.7      | 00.7      | 00.7       | 00.7            | 07 77                 | 00.05                      | 00.00      | 86.7    | (216) |
| (217)m=   | 88.59     |                   | 88.35              | 87.95          | 87.26     | 86.7      | 86.7      | 86.7       | 86.7            | 87.77                 | 88.35                      | 88.63      |         | (217) |
|   |           |                   | kWh/m<br>) ÷ (217) |                |           |           |           |            |                 |                       |                            |            |         |       |
| (219)m=   |           | 159.03            | 165.3              | 146.03         | 142.18    | 124.88    | 117.1     | 132.4      | 133.4           | 151.89                | 163.09                     | 175.88     |         |       |
|   |           |                   |                    |                |           |           |           | Tota       | I = Sum(2       | 19a) <sub>112</sub> = |                            |            | 1792.45 | (219) |
|   | I totals  | ( .)              |                    |                |           |           |           |            |                 | k\                    | Wh/year                    |            | kWh/yea | r<br> |
| Space heating fuel used, main system 1  |           |                   |                    |                |           |           |           |            | 1313.39         |                       |                            |            |         |       |
| Water I   | neating   | fuel use          | d                  |                |           |           |           |            |                 |                       |                            |            | 1792.45 |       |
| Electric  | ity for p | umps, f           | ans and            | electric       | keep-ho   | t         |           |            |                 |                       |                            |            |         |       |
| mechanical ventilation - balanced, extract or positive input from outside 173.81  |           |                   |                    |                |           |           |           | 173.81     |                 | (230a)                |                            |            |         |       |
| central heating pump: 30  |           |                   |                    |                |           |           |           | 30         |                 | (230c)                |                            |            |         |       |
| boiler with a fan-assisted flue   |           |                   |                    |                |           |           |           | 45         |                 | (230e)                |                            |            |         |       |
| Total electricity for the above, kWh/year sum of (230a)(230g) =                   |           |                   |                    |                |           |           |           |            | 248.81          | (231)                 |                            |            |         |       |
| Electricity for lighting  |           |                   |                    |                |           |           |           |            |                 | (232)                 |                            |            |         |       |
|   | •         |                   |                    |                |           |           |           |            |                 |                       |                            |            | 459.05  | (232) |
| -12a. C   | 702 em    | issions -         | – Individ          | ual heat       | ing syste | ems inclu | iding mi  | cro-CHP    | ,               |                       |                            |            |         |       |

|   | <b>Energy</b><br>kWh/year       | Emission factor<br>kg CO2/kWh | <b>Emissions</b><br>kg CO2/year |  |
|---|---------------------------------|-------------------------------|---------------------------------|--|
| Space heating (main system 1)                     | (211) x                         | 0.216 =                       | 283.69 (261)                    |  |
| Space heating (secondary)                         | (215) x                         | 0.519 =                       | 0 (263)                         |  |
| Water heating                                     | (219) x                         | 0.216 =                       | 387.17 (264)                    |  |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                               | 670.86 (265)                    |  |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519 =                       | 129.13 (267)                    |  |
| Electricity for lighting                          | (232) x                         | 0.519 =                       | 238.25 (268)                    |  |
| Total CO2, kg/year                                | sum                             | n of (265)(271) =             | 1038.24 (272)                   |  |
| Dwelling CO2 Emission Rate                        | (272                            | 13.52 (273)                   |                                 |  |
| El rating (section 14)                            |                                 |                               | 89 (274)                        |  |
|   |                                 |                               |                                 |  |



| User Details:   |  |                    |             |  |             |             |            |        |                                   |              |  |  |
|---|--|--------------------|-------------|--|-------------|-------------|------------|--------|-----------------------------------|--------------|--|--|
| Assessor Name:<br>Software Name:  |  |                    |             |  |             |             |            |        |                                   | on: 1.0.4.23 |  |  |
| A dalama a a  | Property Address: Flat 6           Address :         1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON |                    |             |  |             |             |            |        |                                   |              |  |  |
| Address :<br>1. Overall dwelling dimer  |  | Coldnard           | bour Lar    | ne, Loug   | poroug      | gn Junct    | ion, LOP   | IDON   |                                   |              |  |  |
| Ground floor  | 310113.  |                    | -           | Area(m²)         Av. Height(m)           51.7         (1a) x         2.5 |             |             |            | (2a) = | Volume(m <sup>3</sup> )<br>129.25 | (3a)         |  |  |
| Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$<br>51.7 (4)  |  |                    |             |  |             |             |            |        |                                   |              |  |  |
| Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) =$   |  |                    |             |  |             |             |            |        | 129.25                            | (5)          |  |  |
| 2. Ventilation rate:  |  |                    |             |  |             |             |            |        |                                   |              |  |  |
|   |  | econdary<br>eating | / ·         | other  |             | total       |            |        | m <sup>3</sup> per hour           |              |  |  |
| Number of chimneys  | 0 +  | 0                  | ] + L       | 0  |             | 0           |            | -0 =   | 0                                 | (6a)         |  |  |
| Number of open flues  | 0 +  | 0                  | +           | 0  | ] = [       | 0           | x 2        | 20 =   | 0                                 | (6b)         |  |  |
| Number of intermittent fan  | S  |                    |             |  |             | 0           | <b>x</b> 1 | 0 =    | 0                                 | (7a)         |  |  |
| Number of passive vents   |  |                    |             |  |             | 0           | <b>x</b> 1 | 0 =    | 0                                 | (7b)         |  |  |
| Number of flueless gas fires  |  |                    |             |  |             |             |            |        |                                   | (7c)         |  |  |
| Air chaInfiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 0$ $\div$ (5) =   |  |                    |             |  |             |             |            |        | anges per hou                     | ur<br>](8)   |  |  |
| If a pressurisation test has be   |  |                    |             |  | ontinue fro |             |            | . (0)  | 0                                 |              |  |  |
| Number of storeys in the dwelling (ns)<br>Additional infiltration   |  |                    |             |  |             |             |            |        | 0                                 | (9)<br>(10)  |  |  |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction  |  |                    |             |  |             |             |            |        | 0                                 | (11)         |  |  |
| if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35   |  |                    |             |  |             |             |            |        |                                   |              |  |  |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0   |  |                    |             |  |             |             |            |        | 0                                 | (12)         |  |  |
| If no draught lobby, enter 0.05, else enter 0   |  |                    |             |  |             |             |            |        | 0                                 | (13)         |  |  |
| Percentage of windows and doors draught stripped  |  |                    |             |  |             |             |            |        | 0                                 | (14)         |  |  |
| Window infiltration   |  |                    | 0.25 - [0.2 | 0  | (15)        |             |            |        |                                   |              |  |  |
| Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) =$  |  |                    |             |  |             |             |            |        | 0                                 | (16)         |  |  |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area<br>If based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$ |  |                    |             |  |             |             |            | 2      | (17)                              |              |  |  |
| •   | •  |                    |             |  |             | is being us | sed        |        | 0.1                               | (18)         |  |  |
| Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used Number of sides sheltered 3  |  |                    |             |  |             |             |            |        | 3                                 | (19)         |  |  |
| Shelter factor  |  |                    | (           | (20) = 1 - [   | 0.075 x (1  | 9)] =       |            |        | 0.78                              | (20)         |  |  |
| Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$  |  |                    |             |  |             |             |            |        | 0.08                              | (21)         |  |  |
| Infiltration rate modified fo   | r monthly wind speed   | 1                  |             |  |             |             |            |        |                                   |              |  |  |
| Jan Feb M   | Mar Apr May  | Jun                | Jul         | Aug  | Sep         | Oct         | Nov        | Dec    |                                   |              |  |  |
| Monthly average wind spe  | ed from Table 7  |                    |             |  |             |             |            |        |                                   |              |  |  |
| (22)m= 5.1 5 4  | 4.4 4.3  | 3.8                | 3.8         | 3.7  | 4           | 4.3         | 4.5        | 4.7    |                                   |              |  |  |
| Wind Factor (22a)m = (22  | )m ÷ 4   |                    |             |  |             |             |            |        |                                   |              |  |  |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08   | 0.95               | 0.95        | 0.92   | 1           | 1.08        | 1.12       | 1.18   |                                   |              |  |  |

| Adjust   | ed infiltr               | ation rat    | e (allowi      | ng for sl   | nelter an                 | d wind s       | peed) =        | (21a) x         | (22a)m       | -              | -           |           |           |               |
|----------|--------------------------|--------------|----------------|-------------|---------------------------|----------------|----------------|-----------------|--------------|----------------|-------------|-----------|-----------|---------------|
| <b>.</b> | 0.1                      | 0.1          | 0.09           | 0.09        | 0.08                      | 0.07           | 0.07           | 0.07            | 0.08         | 0.08           | 0.09        | 0.09      |           |               |
|          | ate effec<br>echanica    |              | -              | rate for t  | he appli                  | cable ca       | se             |                 |              |                |             |           | 0.5       | (23a)         |
|          |                          |              |                | endix N. (2 | 23b) = (23a               | ) × Fmv (e     | equation (N    | N5)) . othei    | rwise (23b   | ) = (23a)      |             |           | 0.5       | (23a)         |
|          |                          |              |                |             | allowing for              |                |                |                 |              | , (,           |             |           | 73.1      | (23c)         |
|          |                          |              | -              | -           | with hea                  |                |                |                 |              | 2h)m + (       | 23h) 🗙 [′   | 1 – (23c) |           | (200)         |
| (24a)m=  |                          | 0.23         | 0.23           | 0.22        | 0.22                      | 0.21           | 0.21           | 0.21            | 0.21         | 0.22           | 0.22        | 0.23      |           | (24a)         |
|          |                          | d mech       | I<br>anical ve | Intilation  | without                   | heat rec       | L<br>coverv (N | I<br>/\\/) (24b | l = (22)     | l<br>2b)m + (; | 1<br>23h)   |           |           |               |
| (24b)m=  |                          | 0            |                | 0           | 0                         | 0              | 0              | 0               | 0            | 0              | 0           | 0         |           | (24b)         |
|          |                          | ouse ex      | ract ver       | tilation o  | or positiv                | re input v     | ventilatio     | n from c        | utside       |                |             |           |           |               |
| ,        |                          |              |                |             | c) = (23b                 | •              |                |                 |              | 5 × (23b       | )           |           |           |               |
| (24c)m=  | 0                        | 0            | 0              | 0           | 0                         | 0              | 0              | 0               | 0            | 0              | 0           | 0         |           | (24c)         |
| d) If    | natural                  | ventilatio   | on or wh       | ole hous    | se positiv                | e input        | ventilatio     | on from I       | oft          |                |             |           |           |               |
|          | <u> </u>                 | n = 1, th    | en (24d)       | m = (22     | b)m othe                  | rwise (2       | ,<br>          | 0.5 + [(2       | 2b)m² x      | 0.5]           |             |           | 1         |               |
| (24d)m=  |                          | 0            | 0              | 0           | 0                         | 0              | 0              | 0               | 0            | 0              | 0           | 0         |           | (24d)         |
|          |                          |              |                | <u>``</u>   | i) or (24b                | , ,            | , <u>,</u>     | <i>,</i>        | · ,          | r              | 1           | 1         | I         | ()            |
| (25)m=   | 0.23                     | 0.23         | 0.23           | 0.22        | 0.22                      | 0.21           | 0.21           | 0.21            | 0.21         | 0.22           | 0.22        | 0.23      |           | (25)          |
| 3. He    | at l <mark>osse</mark>   | s and he     | eat loss       | oaramet     | er:                       |                |                |                 |              |                |             |           |           |               |
|          |                          | Gros<br>area |                | Openin      | lgs                       | Net Ar<br>A ,r |                | U-valı<br>W/m2  |              | A X U<br>(W/I  |             | k-value   |           | A X k<br>kJ/K |
| Windo    | ws Type                  |              | (111-)         |             |                           | 13.5           |                | [1/( 0.73 )+    |              | 9.58           |             | NJ/111-1  | `         | (27)          |
|          | ws Type                  |              |                |             |                           |                |                | [1/( 0.73 )+    | Ļ            | 2.07           | H           |           |           | (27)          |
| Walls    |                          |              |                | 40.5        |                           | 2.925          |                |                 |              | _              | H r         |           |           |               |
|          |                          | 29           | ,              | 13.5        | =                         | 15.5           |                | 0.15            |              | 2.33           | 닉 ¦         |           |           | (29)          |
| Walls    |                          | 5            |                | 2.92        | 2                         | 2.08           | ×              | 0.15            |              | 0.31           | ╡┟          |           | $\dashv$  | (29)          |
| Walls    |                          | 18           |                | 0           |                           | 18             | ×              | 0.15            | =            | 2.7            |             |           |           | (29)          |
|          | area of e                | iements      | , m²           |             |                           | 52             |                |                 |              |                |             |           |           | (31)          |
| Party    |                          |              |                |             |                           | 44.25          | 5 X            | 0               | =            | 0              | L           |           | $\exists$ | (32)          |
| Party f  |                          |              |                |             |                           | 51.7           |                |                 |              |                | Ĺ           |           | $\_$ $\_$ | (32a)         |
| Party    | Ũ                        |              |                |             |                           | 51.7           |                |                 |              |                | Ĺ           |           |           | (32b)         |
| Interna  | al wall **               |              |                |             |                           | 77             |                |                 |              |                |             |           |           | (32c)         |
|          |                          |              |                |             | indow U-va<br>Is and part |                | ated using     | formula 1.      | /[(1/U-valu  | ie)+0.04] a    | as given in | paragraph | 1 3.2     |               |
| Fabric   | heat los                 | s, W/K       | = S (A x       | U)          |                           |                |                | (26)(30)        | + (32) =     |                |             |           | 16.99     | (33)          |
| Heat c   | apacity                  | Cm = S(      | (Axk)          |             |                           |                |                |                 | ((28)        | .(30) + (32    | 2) + (32a). | (32e) =   | 13882.3   | (34)          |
| Therm    | al mass                  | parame       | ter (TM        | - Cm -      | + TFA) in                 | ı kJ/m²K       |                |                 | Indica       | tive Value     | : Medium    |           | 250       | (35)          |
|          | ign assess<br>used inste |              |                |             | constructi                | ion are not    | t known pr     | ecisely the     | e indicative | values of      | TMP in Ta   | able 1f   |           |               |
|          |                          |              |                |             | using Ap                  | pendix ł       | <              |                 |              |                |             |           | 7.96      | (36)          |
|          | -                        |              | ,              |             | = 0.05 x (3               | -              | -              |                 |              |                |             |           | 1.30      |               |
|          | abric he                 |              |                | . ,         |                           |                |                |                 | (33) +       | (36) =         |             |           | 24.95     | (37)          |
| Ventila  | ation hea                | at loss ca   | alculated      | monthl      | у                         |                |                |                 | (38)m        | = 0.33 × (     | 25)m x (5)  |           |           |               |
|          | Jan                      | Feb          | Mar            | Apr         | May                       | Jun            | Jul            | Aug             | Sep          | Oct            | Nov         | Dec       |           |               |

| (38)m=     | 9.95                | 9.87                              | 9.79        | 9.37                     | 9.29           | 8.88        | 8.88       | 8.79        | 9.04       | 9.29                      | 9.46                   | 9.62      |         | (38) |
|------------|---------------------|-----------------------------------|-------------|--------------------------|----------------|-------------|------------|-------------|------------|---------------------------|------------------------|-----------|---------|------|
| Heat tr    | ansfer o            | coefficie                         | nt, W/K     |                          |                |             |            |             | (39)m      | = (37) + (3               |                        |           |         |      |
| (39)m=     | 34.9                | 34.82                             | 34.73       | 34.32                    | 34.24          | 33.82       | 33.82      | 33.74       | 33.99      | 34.24                     | 34.4                   | 34.57     |         |      |
| Hoot lo    |                     | motor (l                          | HLP), W/    | /m2k                     |                |             |            |             |            | Average =<br>= (39)m ÷    |                        | 12 /12=   | 34.3    | (39) |
| (40)m=     | 0.68                | 0.67                              | 0.67        | 0.66                     | 0.66           | 0.65        | 0.65       | 0.65        | 0.66       | = (39)III ÷               | 0.67                   | 0.67      |         |      |
| (10)       | 0.00                | 0.01                              | 0.07        | 0.00                     | 0.00           | 0.00        | 0.00       | 0.00        |            | Average =                 |                        |           | 0.66    | (40) |
| Numbe      | r of day            | /s in mo                          | nth (Tab    | le 1a)                   |                |             |            |             |            |                           |                        |           |         |      |
|            | Jan                 | Feb                               | Mar         | Apr                      | May            | Jun         | Jul        | Aug         | Sep        | Oct                       | Nov                    | Dec       |         |      |
| (41)m=     | 31                  | 28                                | 31          | 30                       | 31             | 30          | 31         | 31          | 30         | 31                        | 30                     | 31        |         | (41) |
|            |                     |                                   |             |                          |                |             |            |             |            |                           |                        |           |         |      |
| 4. Wa      | ter hea             | ting ene                          | rgy requi   | irement:                 |                |             |            |             |            |                           |                        | kWh/ye    | ar:     |      |
| if TF.     | A > 13.             | upancy, l<br>9, N = 1<br>9, N = 1 |             | : [1 - exp               | (-0.0003       | 349 x (TF   | FA -13.9)  | )2)] + 0.(  | )013 x (   | TFA -13.                  |                        | 74        |         | (42) |
| Annual     | averag              | je hot wa                         |             | ge in litre              |                |             |            |             |            |                           |                        | .53       |         | (43) |
|            |                     | -                                 |             | usage by<br>r day (all w |                | -           | -          | to achieve  | a water us | se target o               | f                      |           |         |      |
|            | Jan                 | Feb                               | ,<br>Mar    | Apr                      | May            | Jun         | Jul        | Aug         | Sep        | Oct                       | Nov                    | Dec       |         |      |
| Hot wate   |                     |                                   |             | ach month                |                |             |            | <u> </u>    | Geb        | 001                       | 1100                   | Dec       |         |      |
| (44)m=     | <mark>8</mark> 3.08 | 80.06                             | 77.04       | 74.02                    | 71             | 67.98       | 67.98      | 71          | 74.02      | 77.04                     | 80.06                  | 83.08     |         |      |
|            |                     |                                   |             |                          |                |             |            |             |            | L<br>Total = Su           |                        |           | 906.36  | (44) |
| Energy o   | ontent of           | <sup>t</sup> hot water            | used - cal  | culated mo               | onthly $= 4$ . | 190 x Vd,r  | n x nm x D | )Tm / 3600  | ) kWh/mor  | nth ( <mark>see Ta</mark> | bles 1b, 1             | c, 1d)    |         |      |
| (45)m=     | 123.21              | 107.76                            | 111.2       | 96.95                    | 93.02          | 80.27       | 74.38      | 85.36       | 86.37      | 10 <mark>0.66</mark>      | 109.88                 | 119.32    |         | _    |
| lf instant | aneous w            | vater heati                       | ng at point | t of use (no             | o hot water    | r storage), | enter 0 in | boxes (46   |            | Tota <mark>l = Su</mark>  | m(45) <sub>112</sub> = | -         | 1188.38 | (45) |
| (46)m=     | 18.48               | 16.16                             | 16.68       | 14.54                    | 13.95          | 12.04       | 11.16      | 12.8        | 12.96      | 15.1                      | 16.48                  | 17.9      |         | (46) |
| Water      |                     |                                   |             |                          |                |             |            |             |            |                           |                        |           |         | . ,  |
| Storage    | e volum             | ne (litres)                       | includir    | ng any so                | olar or W      | /WHRS       | storage    | within sa   | ame ves    | sel                       |                        | 0         |         | (47) |
|            | •                   | •                                 |             | ank in dw                | •              |             |            | ` '         | <b>`</b>   | (0) : (                   | 4 >                    |           |         |      |
| Water :    |                     |                                   | not wate    | er (this ir              | iciudes i      | nstantar    | ieous co   | indi idmo   | ers) ente  | er 'O' in (               | 47)                    |           |         |      |
|            | -                   |                                   | eclared I   | oss facto                | or is kno      | wn (kWł     | n/day):    |             |            |                           |                        | 0         |         | (48) |
| Tempe      | rature f            | actor fro                         | m Table     | 2b                       |                |             | • /        |             |            |                           |                        | 0         |         | (49) |
| Energy     | lost fro            | om water                          | · storage   | e, kWh/ye                | ear            |             |            | (48) x (49) | ) =        |                           |                        | 0         |         | (50) |
| ,          |                     |                                   |             | cylinder l               |                |             |            |             |            |                           |                        |           |         |      |
|            |                     | -                                 | ee secti    | rom Tabl                 | e 2 (kW        | h/litre/da  | iy)        |             |            |                           |                        | 0         |         | (51) |
|            | •                   | from Ta                           |             | 011 4.5                  |                |             |            |             |            |                           |                        | 0         |         | (52) |
|            |                     |                                   | m Table     | 2b                       |                |             |            |             |            |                           |                        | 0         |         | (53) |
| Energy     | lost fro            | om water                          | · storage   | e, kWh/ye                | ear            |             |            | (47) x (51) | x (52) x ( | 53) =                     |                        | 0         |         | (54) |
| Enter      | (50) or             | (54) in (5                        | 55)         |                          |                |             |            |             |            |                           |                        | 0         |         | (55) |
| Water      | storage             | loss cal                          | culated f   | for each                 | month          |             |            | ((56)m = (  | 55) × (41) | m                         |                        |           |         |      |
| (56)m=     | 0                   | 0                                 | 0           | 0                        | 0              | 0           | 0          | 0           | 0          | 0                         | 0                      | 0         |         | (56) |
| If cylinde | r contain           | s dedicate                        | d solar sto | orage, (57)              | m = (56)m      | x [(50) – ( | H11)] ÷ (5 | 0), else (5 | 7)m = (56) | m where (                 | H11) is fro            | m Appendi | кН      |      |
| (57)m=     | 0                   | 0                                 | 0           | 0                        | 0              | 0           | 0          | 0           | 0          | 0                         | 0                      | 0         |         | (57) |

| Primary circuit loss (annual) from Table 3<br>Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m |               |               |             |            |           |                |                       |                  |                           |              |             |                         | (58) |
|---|---------------|---------------|-------------|------------|-----------|----------------|-----------------------|------------------|---------------------------|--------------|-------------|-------------------------|------|
| (modified   | by factor f   | rom Tab       | le H5 if t  | here is s  | solar wat | ter heati      | ng and a              | a cylinde        | r thermo                  | stat)        |             |                         |      |
| (59)m= 0  | 0             | 0             | 0           | 0          | 0         | 0              | 0                     | 0                | 0                         | 0            | 0           |                         | (59) |
| Combi loss o  | calculated    | for each      | month       | (61)m =    | (60) ÷ 30 | 65 × (41       | )m                    |                  |                           |              |             |                         |      |
| (61)m= 11.77  | 7 10.62       | 11.74         | 11.35       | 11.72      | 11.32     | 11.69          | 11.71                 | 11.34            | 11.73                     | 11.37        | 11.76       |                         | (61) |
| Total heat re   | quired for    | water h       | eating ca   | alculated  | for eac   | h month        | (62)m =               | 0.85 × 0         | (45)m +                   | (46)m +      | (57)m +     | (59)m + (6 <sup>-</sup> | 1)m  |
| (62)m= 134.9  | 8 118.38      | 122.94        | 108.29      | 104.74     | 91.59     | 86.07          | 97.06                 | 97.71            | 112.39                    | 121.25       | 131.09      |                         | (62) |
| Solar DHW inpu  | ut calculated | using App     | endix G o   | r Appendix | H (negati | ve quantity    | y) (enter '0          | ' if no sola     | r contribut               | ion to wate  | er heating) |                         |      |
| (add additior   | nal lines if  | FGHRS         | and/or \    | WWHRS      | applies   | , see Ap       | pendix (              | G)               |                           |              |             | _                       |      |
| (63)m= 0  | 0             | 0             | 0           | 0          | 0         | 0              | 0                     | 0                | 0                         | 0            | 0           |                         | (63) |
| Output from   | water hea     | ater          |             |            |           |                |                       |                  |                           |              |             |                         |      |
| (64)m= 134.9  | 8 118.38      | 122.94        | 108.29      | 104.74     | 91.59     | 86.07          | 97.06                 | 97.71            | 112.39                    | 121.25       | 131.09      |                         |      |
|   |               |               |             |            |           |                | Outp                  | out from w       | ater heate                | r (annual)₁  | 12          | 1326.51                 | (64) |
| Heat gains f  | rom water     | heating       | , kWh/m     | onth 0.2   | 5 ´ [0.85 | × (45)m        | n + (61)m             | n] + 0.8 x       | k [(46)m                  | + (57)m      | + (59)m     | ]                       |      |
| (65)m= 43.9 <sup>4</sup>  | 38.49         | 39.91         | 35.07       | 33.86      | 29.52     | 27.66          | 31.31                 | 31.55            | 36.4                      | 39.38        | 42.62       |                         | (65) |
| include (5  | 7)m in cal    | culation      | of (65)m    | only if c  | ylinder i | s in the o     | dwelling              | or hot w         | ate <mark>r is f</mark> r | om com       | munity h    | leating                 |      |
| 5. Internai   | gains (see    | e Table {     | 5 and 5a    | ):         |           |                |                       |                  |                           |              |             |                         |      |
| Metabolic ga  | ains (Table   | e 5). Wat     | ts          |            |           |                |                       |                  |                           |              |             |                         |      |
| Jar   |               | Mar           | Apr         | May        | Jun       | Jul            | Aug                   | Sep              | Oct                       | Nov          | Dec         |                         |      |
| (66)m= 87.0 <sup>4</sup>  | I 87.01       | <b>87</b> .01 | 87.01       | 87.01      | 87.01     | 87.01          | 87.01                 | 87.01            | 8 <mark>7.01</mark>       | 87.01        | 87.01       |                         | (66) |
| Ligh <mark>ting g</mark> air  | is (calcula   | ted in A      | opendix     | L, equat   | ion L9 o  | r L9a), a      | llso see <sup>:</sup> | Table 5          | •                         |              |             |                         |      |
| (67)m= 18.06  | 6 16.04       | 13.04         | 9.88        | 7.38       | 6.23      | 6.73           | 8.75                  | 11.75            | 14.92                     | 17.41        | 18.56       |                         | (67) |
| Appliances g  | gains (calo   | culated ir    | n Appeno    | dix L, eq  | uation L  | 13 or L1       | 3a), also             | see Ta           | ble 5                     |              |             |                         |      |
| (68)m= 151.6  | 5 153.22      | 149.26        | 140.81      | 130.16     | 120.14    | 113.45         | 111.88                | 115.84           | 124.28                    | 134.94       | 144.96      |                         | (68) |
| Cooking gai   | ns (calcula   | ated in A     | ppendix     | L, equat   | tion L15  | or L15a        | ), also se            | e Table          | 5                         |              | •           | I                       |      |
| (69)m= 31.7   | 31.7          | 31.7          | 31.7        | 31.7       | 31.7      | 31.7           | 31.7                  | 31.7             | 31.7                      | 31.7         | 31.7        |                         | (69) |
| Pumps and   | fans gains    | (Table        | 5a)         |            |           |                | <u>.</u>              |                  |                           |              |             | I                       |      |
| (70)m= 3  | 3             | 3             | 3           | 3          | 3         | 3              | 3                     | 3                | 3                         | 3            | 3           |                         | (70) |
| Losses e.g.   | evaporatio    | n (nega       | tive valu   | es) (Tab   | le 5)     |                |                       |                  |                           |              |             | I                       |      |
| (71)m= -69.6  |               | -69.61        | -69.61      | -69.61     | -69.61    | -69.61         | -69.61                | -69.61           | -69.61                    | -69.61       | -69.61      |                         | (71) |
| Water heatir  | ng gains (    | Table 5)      |             |            |           |                |                       |                  |                           |              |             | 1                       |      |
| (72)m= 59.02  | <u> </u>      | 53.64         | 48.71       | 45.51      | 41        | 37.17          | 42.08                 | 43.82            | 48.93                     | 54.69        | 57.28       |                         | (72) |
| Total intern  | al gains =    |               |             |            | (66)      | u<br>m + (67)m | ⊥<br>∩ + (68)m -      | ۱<br>+ (69)m + ۱ | !<br>(70)m + (7           | 1)m + (72)   | )m          | 1                       |      |
| (73)m= 280.8  |               | 268.05        | 251.5       | 235.15     | 219.48    | 209.46         | 214.81                | 223.52           | 240.23                    | 259.15       | 272.9       |                         | (73) |
| 6. Solar gai  |               | 1             | 1           | 1          | 1         | 1              | I                     | 1                | 1                         | 1            | I           |                         |      |
| Solar gains ar  |               | using sola    | r flux from | Table 6a   | and assoc | iated equa     | ations to co          | onvert to th     | ne applicat               | ole orientat | tion.       |                         |      |
| Orientation:  | Access I      | actor         | Area        |            | Flu       | x              |                       | q                |                           | FF           |             | Gains                   |      |

| Orientation:  | Access Facto<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |     | Gains<br>(W) |      |
|---------------|--------------------------|---|------------|---|------------------|---|----------------|---|----------------|-----|--------------|------|
| Northeast 0.9 | 0.77 0.77                | × | 2.92       | x | 11.28            | x | 0.63           | × | 0.1            | =   | 1.44         | (75) |
| Northeast 0.9 | 0.77 0.77                | × | 2.92       | × | 22.97            | x | 0.63           | x | 0.1            | ] = | 2.93         | (75) |

| <b>N</b> 1 <i>A</i> 1 <i>A</i> |                                 |            |            |           | _         |             | -            |              |                      |               |        |       |      |
|--------------------------------|---------------------------------|------------|------------|-----------|-----------|-------------|--------------|--------------|----------------------|---------------|--------|-------|------|
| Northeast 0.9                  | •                               | X          | 2.9        | 2         | ×         | 41.38       | ×            | 0.63         | ×                    | 0.1           | =      | 5.28  | (75) |
| Northeast 0.9                  | •                               | ×          | 2.9        | 2         | ×         | 67.96       | ×            | 0.63         | ×                    | 0.1           | =      | 8.68  | (75) |
| Northeast 0.9                  |                                 | ×          | 2.9        | 2         | ×         | 91.35       | X            | 0.63         | ×                    | 0.1           | =      | 11.67 | (75) |
| Northeast 0.9                  | •                               | X          | 2.9        | 2         | ×         | 97.38       | ×            | 0.63         | ×                    | 0.1           | =      | 12.44 | (75) |
| Northeast 0.9                  | x 0.77                          | x          | 2.9        | 2         | ×         | 91.1        | x            | 0.63         | ×                    | 0.1           | =      | 11.63 | (75) |
| Northeast 0.9                  | × 0.77                          | x          | 2.9        | 2         | x         | 72.63       | ×            | 0.63         | ×                    | 0.1           | =      | 9.27  | (75) |
| Northeast 0.9                  | x 0.77                          | x          | 2.9        | 2         | x         | 50.42       | ×            | 0.63         | x                    | 0.1           | =      | 6.44  | (75) |
| Northeast 0.9                  | x 0.77                          | x          | 2.9        | 2         | x         | 28.07       | ×            | 0.63         | x                    | 0.1           | =      | 3.58  | (75) |
| Northeast 0.9                  | x 0.77                          | x          | 2.9        | 2         | x         | 14.2        | ×            | 0.63         | ×                    | 0.1           | =      | 1.81  | (75) |
| Northeast 0.9                  | x 0.77                          | x          | 2.9        | 2         | x         | 9.21        | x            | 0.63         | ×                    | 0.1           | =      | 1.18  | (75) |
| Southwesto.                    | x 0.77                          | x          | 13.        | 5         | x         | 36.79       |              | 0.63         | x                    | 0.1           | =      | 21.69 | (79) |
| Southwesto.                    | x 0.77                          | x          | 13.        | 5         | x         | 62.67       |              | 0.63         | x                    | 0.1           | =      | 36.94 | (79) |
| Southwesto.                    | x 0.77                          | x          | 13.        | 5         | x         | 85.75       |              | 0.63         | ×                    | 0.1           | =      | 50.54 | (79) |
| Southwesto.                    | x 0.77                          | x          | 13.        | 5         | x         | 106.25      | ]            | 0.63         | x                    | 0.1           | =      | 62.62 | (79) |
| Southwesto.                    | x 0.77                          | x          | 13.        | 5         | x         | 119.01      | ]            | 0.63         | x                    | 0.1           | =      | 70.14 | (79) |
| Southwest0.9                   | x 0.77                          | x          | 13.        | 5         | x         | 118.15      | ]            | 0.63         | ×                    | 0.1           | =      | 69.64 | (79) |
| Southwest0.9                   | x 0.77                          | x          | 13.        | 5         | x         | 113.91      | 1            | 0.63         | ×                    | 0.1           | =      | 67.14 | (79) |
| Southwesto.                    | x 0.77                          | x          | 13.        | 5         | ×         | 104.39      |              | 0.63         | x                    | 0.1           | =      | 61.53 | (79) |
| Southwest <mark>0.9</mark>     | x 0.77                          | ×          | 13.        | 5         | x         | 92.85       | 1.           | 0.63         | x                    | 0.1           |        | 54.73 | (79) |
| Southwest0.9                   | × 0.77                          | ×          | 13.        | 5         | x         | 69.27       | 1            | 0.63         | x                    | 0.1           | =      | 40.83 | (79) |
| Sout <mark>hwest</mark> 0.9    | × 0.77                          | x          | 13.        | 5         | ×         | 44.07       | Ī/           | 0.63         | x                    | 0.1           | =      | 25.98 | (79) |
| Sout <mark>hwest</mark> 0.9    | x 0.77                          | ×          | 13.        | 5         | × 「       | 31.49       | 1            | 0.63         | x                    | 0.1           | =      | 18.56 | (79) |
|                                |                                 |            |            |           |           |             |              |              |                      |               |        |       |      |
| Solar gains                    | in watts, cal                   | culated    | for each   | n month   |           |             | (83)m        | n = Sum(74)m | ( <mark>8</mark> 2)m |               |        |       |      |
| (83)m= 23.1                    | 3 39.87                         | 55.83      | 71.3       | 81.81     | 82.0      | 78.77       | 70           | .8 61.17     | 44.41                | 27.79         | 19.74  |       | (83) |
| Total gains                    | <ul> <li>internal an</li> </ul> | nd solar   | (84)m =    | . ,       | + (83     |             |              |              |                      |               |        |       |      |
| (84)m= 303.                    | 95 318.51                       | 323.87     | 322.81     | 316.96    | 301.      | 55 288.23   | 285          | .61 284.68   | 284.64               | 286.93        | 292.63 |       | (84) |
| 7. Mean in                     | ternal tempe                    | erature (  | (heating   | season    | )         |             |              |              |                      |               |        |       |      |
| Temperatu                      | re during he                    | eating po  | eriods in  | the livi  | ng ar     | ea from Ta  | ble 9        | , Th1 (°C)   |                      |               |        | 21    | (85) |
| Utilisation                    | factor for gai                  | ins for li | iving are  | a, h1,m   | i (see    | Table 9a)   |              |              |                      | _             |        |       |      |
| Ja                             | n Feb                           | Mar        | Apr        | May       | Ju        | n Jul       | A            | ug Sep       | Oct                  | Nov           | Dec    |       |      |
| (86)m= 1                       | 0.99                            | 0.99       | 0.97       | 0.89      | 0.7       | 0.52        | 0.5          | 54 0.79      | 0.96                 | 0.99          | 1      |       | (86) |
| Mean inter                     | nal tempera                     | ture in l  | iving are  | ea T1 (fo | ollow     | steps 3 to  | 7 in T       | able 9c)     |                      |               |        |       |      |
| (87)m= 20.4                    | 4 20.52                         | 20.64      | 20.79      | 20.93     | 20.9      | 9 21        | 2            | 1 20.98      | 20.84                | 20.61         | 20.43  |       | (87) |
| Temperatu                      | re during he                    | ating p    | eriods in  | rest of   | dwel      | ing from Ta | able 9       | 9. Th2 (°C)  | -                    | -             |        |       |      |
| (88)m= 20.3                    | T                               | 20.37      | 20.37      | 20.37     | 20.3      | <u> </u>    | 20.          | - i          | 20.37                | 20.37         | 20.37  | ]     | (88) |
|                                | factor for gai                  | ine for r  | rest of du | velling   | 1<br>h2 m |             | . 0.2)       | I            | I                    |               |        | 1     |      |
| (89)m= 1                       | 0.99                            | 0.99       | 0.96       | 0.86      | 0.6       | <u>`</u>    | <u>, 9a)</u> | 47 0.73      | 0.95                 | 0.99          | 1      | 1     | (89) |
|                                |                                 |            |            |           |           |             |              |              |                      |               |        | 1     |      |
| Mean inter<br>(90)m= 19.6      | nal tempera                     | 19.89      | 20.12      | 20.3      | ing 12    | <u> </u>    | eps 3        | 1            | le 9c)<br>20.18      | 19.87         | 19.59  | 1     | (90) |
| (90)11= 19.0                   | 19.72                           | 19.09      | 20.12      | 20.3      | 20.3      | 20.30       | 20.          |              |                      |               |        |       |      |
|                                |                                 |            |            |           |           |             |              |              | fIA – Liv            | ing area ÷ (4 | 4) =   | 0.51  | (91) |

| (92)m=   |   |   | ar the such   | ala duva   | lling) f  | I A T4                                  | . /1 fl                                 | A) TO                                       |  |   |   |                       |  |
|--|---|---|---|--|---|---|---|---|--|---|---|-----------------------|--|
| (02)=  | internal temp<br>20.03 20.12  | `   | 20.46   | 20.62  | 1100) = 1<br>20.69                              | 20.69                                   | + (1 — IL<br>20.69                      | A) × 12                                     | 20.51  | 20.25   | 20.01                                     |                       | (92)   |
| L<br>Apply   | adjustment to   |   |   |  |   |   |   |   |  | 20.20   | 20.01                                     |                       | ()   |
| (93)m=   | 19.88 19.97   |   | 20.31   | 20.47  | 20.54   | 20.54                                   | 20.54                                   | 20.52                                       | 20.36  | 20.1  | 19.86                                     |                       | (93)   |
| L  | ce heating re   | quiremen  | t   |  |   |   |   |   |  |   |   |                       |  |
|  | to the mean   |   |   | re obtain  | ed at st  | ep 11 of                                | Table 9t                                | o, so tha                                   | t Ti,m=(   | 76)m an   | d re-calc                                 | ulate                 |  |
| the uti  | lisation factor   |   | <del>1 – – –</del>  |  | r   |   |   |   |  |   |   | 1                     |  |
| L  | Jan Feb   |   | Apr   | May  | Jun   | Jul                                     | Aug                                     | Sep   | Oct  | Nov   | Dec                                       |                       |  |
|  | tion factor for   | <u> </u>  | 1   | 0.00   | 0.00  | 0.40                                    | 0.40                                    | 0.74  | 0.05   | 0.00  | 4   |                       | (94)   |
| (94)m=   | 1 0.99  | 0.98  | 0.95  | 0.86   | 0.66  | 0.46                                    | 0.49                                    | 0.74  | 0.95   | 0.99  | 1   |                       | (94)   |
| (95)m=   | gains, hmGr<br>302.56 316.0   | `   | 308.07  | +)III<br>273.6   | 198.24  | 133.27                                  | 139.63                                  | 211.74                                      | 269.34   | 283.86  | 291.6                                     |                       | (95)   |
| Ľ  | ly average ex   |   |   |  |   | 100.21                                  | 100.00                                  | 2   | 200.01   | 200.00  | 20110                                     |                       | ()   |
| (96)m=   | 4.3 4.9   | 6.5   | 8.9   | 11.7   | 14.6  | 16.6                                    | 16.4                                    | 14.1  | 10.6   | 7.1   | 4.2                                       |                       | (96)   |
|  | oss rate for m  | ean interr  | nal tempo   | erature,   | LLL M , W :                                     | I<br>=[(39)m :                          | x [(93)m·                               | – (96)m                                     | ]  |   |   |                       |  |
| (97)m=   | 543.83 524.7  | 3 473.01  | 391.71  | 300.21   | 200.82  | 133.41                                  | 139.85                                  | 218.37                                      | 334.29   | 447.12  | 541.43                                    |                       | (97)   |
| Space  | heating requ  | irement fo  | r each n  | nonth, k\  | Nh/mon  | th = 0.02                               | 24 x [(97)                              | )m – (95                                    | )m] x (4 <sup>-</sup>  | 1)m   |   |                       |  |
| (98)m=   | 179.51 140.2  | 5 114.92  | 60.22   | 19.8   | 0   | 0                                       | 0                                       | 0   | 48.32  | 117.54  | 185.87                                    |                       |  |
| _  |   |   |   |  |   |   | Tota                                    | l per year                                  | (kWh/year  | ) = Sum(9   | 8)15,912 =                                | 866.43                | (98)   |
| Sp <mark>ace</mark>  | heating requ  | irement ir  | n kWh/m²  | /year  |   |   |   |   |  |   |   | 16.76                 | (99)   |
| 9a. Ene  | rgy requirem  | ents – Ind  | ividual h   | eating sv  | vstems i  | ncluding                                | micro-C                                 | HP)   |  |   |   |                       |  |
|  | heating:  |   |   |  | 7   |   |   |   |  |   |   |                       |  |
| Fractic  | on of space h   | eat from s  | econdar   | y/supple   | mentary   | ' system                                |   |   |  |   |   | 0                     | (201)  |
| Fractio  | on of space h   | eat from n  | nain syst   | em(s)  |   |   | (202) = 1 -                             | - (201) =                                   |  |   |   | 1                     | (202)  |
| Fractio  | on of total hea   | ting from   | main sys  | stem 1   |   |   | (204) = (20                             | 02) × [1 –                                  | (203)] =   |   |   | 1                     |  |
| Efficie  | ncy of main s   | nace heat   |   |  |   |   |   |   |  |   |   |                       | (204)  |
| Efficie  |   | pube neu  | ting syste  | em 1 📃   |   |   |   |   |  |   |   | 89.9                  | (204)  |
|  | ncy of second   |   | • •   |  | g systen  | n, %                                    |   |   |  |   |   |                       |  |
| Г  | - 1   | lary/suppl  | ementar   | y heating  |   |   | Aug                                     | Sep   | Oct  | Nov   | Dec                                       | 89.9<br>0             | (206)<br>(208)                                   |
| [<br>Space   | Jan Fetherating requ  | lary/suppl  | ementar<br>Apr  | y heating<br>May   | Jun   | n, %<br>Jul                             | Aug                                     | Sep   | Oct  | Nov   | Dec                                       | 89.9                  | (206)<br>(208)                                   |
| [<br>Space   | Jan Fet   | lary/suppl<br>Mar<br>irement (d   | ementar<br>Apr  | y heating<br>May   | Jun   |   | Aug<br>0                                | Sep<br>0                                    | Oct<br>48.32   | Nov<br>117.54   | Dec<br>185.87                             | 89.9<br>0             | (206)<br>(208)                                   |
|  | Jan Fet<br>heating requ   | dary/suppl<br>Mar<br>irement (0<br>114.92   | Apr<br>Calculate<br>60.22   | y heating<br>May<br>d above)<br>19.8   | Jun   | Jul                                     |   |   |  |   |   | 89.9<br>0             | (206)<br>(208)                                   |
|  | Jan Fel<br>heating requ<br>179.51 140.2   | dary/suppl<br>Mar<br>irement (0<br>114.92<br>204)] } x ^  | Apr<br>Calculate<br>60.22   | y heating<br>May<br>d above)<br>19.8   | Jun   | Jul                                     |   |   |  |   |   | 89.9<br>0             | (206)<br>(208)<br>ear                            |
|  | Jan Fel<br>heating requ<br>179.51 140.2<br>= {[(98)m x (2   | dary/suppl<br>Mar<br>irement (0<br>114.92<br>204)] } x ^  | ementar<br>Apr<br>calculate<br>60.22  | y heating<br>May<br>d above)<br>19.8   | Jun<br>)<br>0                                   | Jul<br>0                                | 0                                       | 0   | 48.32<br>53.75   | 117.54<br>130.75  | 185.87<br>206.75                          | 89.9<br>0             | (206)<br>(208)<br>ear                            |
| (211)m   | Jan Fel<br>heating requ<br>179.51 140.2<br>= {[(98)m x (2   | Hary/suppl       Mar       irement (d       114.92       204)] } x ^       1 127.83   | Apr           calculate           60.22           100 ÷ (20           66.98   | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03                                       | Jun<br>)<br>0                                   | Jul<br>0                                | 0                                       | 0   | 48.32<br>53.75   | 117.54<br>130.75  | 185.87<br>206.75                          | 0<br>kWh/ye           | (206)<br>(208)<br>ear<br>(211)                   |
| (211)m<br>Space  | Jan         Feb           heating requ           179.51         140.2           = {[(98)m x (2000)]           199.67         156.0  | dary/suppl         Mar         irement (d         114.92         204)] } x          1         127.83         (secondal)   | ementar<br>Apr<br>calculate<br>60.22<br>100 ÷ (20<br>66.98  | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03                                       | Jun<br>)<br>0                                   | Jul<br>0                                | 0                                       | 0   | 48.32<br>53.75   | 117.54<br>130.75  | 185.87<br>206.75                          | 0<br>kWh/ye           | (206)<br>(208)<br>ear<br>(211)                   |
| (211)m<br>Space  | Jan         Feb           heating requ           179.51         140.2           = {[(98)m x (100)           199.67         156.0           heating fuel   | dary/suppl         Mar         irement (d         114.92         204)] } x          1         127.83         (secondal)   | ementar<br>Apr<br>calculate<br>60.22<br>100 ÷ (20<br>66.98  | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03                                       | Jun<br>)<br>0                                   | Jul<br>0                                | 0<br>Tota<br>0                          | 0<br>I (kWh/yea                             | 48.32<br>53.75<br>ar) =Sum(2<br>0  | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0                                      | 185.87<br>206.75<br>-                     | 0<br>kWh/ye           | (206)<br>(208)<br>(208)<br>(211)<br>(211)        |
| (211)m<br>[<br>Space<br>= {[(98)   | Jan         Feb           heating requ           179.51         140.2           = {[(98)m x (x)           199.67         156.0           heating fuel           m x (201)] } x  | dary/suppl<br>irement (<br>114.92<br>204)] } x ^<br>1 127.83<br>(secondar<br>100 ÷ (20  | ementar<br>Apr<br>calculate<br>60.22<br>100 ÷ (20<br>66.98  | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month                              | Jun           0           0                     | Jul<br>0                                | 0<br>Tota<br>0                          | 0<br>0<br>I (kWh/yea                        | 48.32<br>53.75<br>ar) =Sum(2<br>0  | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0                                      | 185.87<br>206.75<br>-                     | 0<br>kWh/ye           | (206)<br>(208)<br>ear<br>(211)                   |
| (211)m<br>(211)m<br>= {[(98)]<br>(215)m=<br>Water H  | Jan     Fet       heating requ       179.51     140.2       = {[(98)m x (100)       199.67     156.0       heating fuel       m x (201)] } x       0     0  | dary/suppl         Mar         irement (r         5       114.92         204)] } x ^         1       127.83         (secondar         100 ÷ (20         0   | ementar<br>Apr<br>calculate<br>60.22<br>100 ÷ (20<br>66.98<br>ry), kWh/<br>08)<br>0   | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month<br>0                         | Jun           0           0                     | Jul<br>0                                | 0<br>Tota<br>0                          | 0<br>I (kWh/yea                             | 48.32<br>53.75<br>ar) =Sum(2<br>0  | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0                                      | 185.87<br>206.75<br>-                     | 89.9<br>0<br>kWh/ye   | (206)<br>(208)<br>(208)<br>(211)<br>(211)        |
| (211)m<br>(211)m<br>= {[(98)]<br>(215)m=<br>Water H  | Jan     Fet       heating requ       179.51     140.2       = {[(98)m x (i       199.67     156.0       heating fuel       m x (201)] } x       0     0   | dary/suppl         dary/suppl         irement (c         5       114.92         204)] } x ^         1       127.83         (secondar         100 ÷ (20         0         0         0  | ementar<br>Apr<br>calculate<br>60.22<br>100 ÷ (20<br>66.98<br>ry), kWh/<br>08)<br>0   | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month<br>0                         | 0<br>0  | Jul           0           0           0 | 0<br>Tota<br>0<br>Tota                  | 0<br>I (kWh/yea<br>0<br>I (kWh/yea          | 48.32<br>53.75<br>ar) =Sum(2<br>0<br>ar) =Sum(2                              | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>           | 185.87<br>206.75<br>=<br>0                | 89.9<br>0<br>kWh/ye   | (206)<br>(208)<br>(208)<br>(211)<br>(211)        |
| (211)m<br>Space<br>= {[(98);<br>(215)m=<br>Water H<br>Output   | Jan       Feb         heating requ         179.51       140.2         = {[(98)m x (100)         199.67       156.0         heating fuel         m x (201)] } x         0       0         heating fuel         m x (201)] } x         0       0         heating fuel         134.98       118.3  | dary/suppl         dary/suppl         irement (d         5       114.92         204)] } x '         1       127.83         (secondar         100 ÷ (20         0         eater (calc         3       122.94   | ementar<br>Apr<br>calculate<br>60.22<br>100 ÷ (20<br>66.98<br>ry), kWh/<br>08)<br>0   | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month<br>0                         | Jun           0           0                     | Jul<br>0                                | 0<br>Tota<br>0                          | 0<br>I (kWh/yea                             | 48.32<br>53.75<br>ar) =Sum(2<br>0  | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0                                      | 185.87<br>206.75<br>-                     | 0<br>kWh/ye<br>963.78 | (206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211) |
| (211)m<br>(211)m<br>(215)m=<br>(215)m=<br>(215)m=<br>(215)m=<br>(215)m=<br>(215)m=<br>(215)m=<br>(215)m=<br>(215)m=<br>(215)m=<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m<br>(211)m | Jan       Fet         heating requ         179.51       140.2         = {[(98)m x (i         199.67       156.0         heating fuel         m x (201)] } x         0       0         heating fuel         m x (201)] } x         0       0         heating fuel         134.98       118.3         cy of water here  | dary/suppl         dary/suppl         irement (c         5       114.92         204)]       } x ^         1       127.83         (secondar         100 ÷ (20         0         eater (calc         3       122.94         eater   | ementar<br>Apr<br>calculate<br>60.22<br>100 ÷ (20<br>66.98<br>ry), kWh/<br>08)<br>0<br>culated a<br>108.29  | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month<br>0<br>0<br>bove)<br>104.74 | Jun       0       0       0       0       91.59 | Jul       0       0       0       86.07 | 0<br>Tota<br>0<br>Tota<br>97.06         | 0<br>I (kWh/yea<br>0<br>I (kWh/yea<br>97.71 | 48.32<br>53.75<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>112.39                    | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>121.25 | 185.87<br>206.75<br>=<br>0<br>=<br>131.09 | 89.9<br>0<br>kWh/ye   | (211)<br>(211)<br>(215)<br>(216)                 |
| (211)m<br>(211)m<br>= {[(98);<br>(215)m=<br>Water H<br>Output<br>Efficien<br>(217)m=   | Jan       Fet         heating requ         179.51       140.2         = {[(98)m x (199.67)       156.0         heating fuel       156.0         heating fuel       0         m x (201)] } x       0         0       0         heating fuel       118.3         from water he       134.98         134.98       118.3         cy of water h       88.5   | dary/suppl         dary/suppl         irement (n         5       114.92         204)] } x ^         1       127.83         (secondar         100 ÷ (20         0         eater (calc         3       122.94         eater         88.22   | ementar         Apr         calculate         60.22         100 ÷ (20         66.98         ry), kWh/         0         culated a         108.29         87.82              | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month<br>0                         | 0<br>0  | Jul           0           0           0 | 0<br>Tota<br>0<br>Tota                  | 0<br>I (kWh/yea<br>0<br>I (kWh/yea          | 48.32<br>53.75<br>ar) =Sum(2<br>0<br>ar) =Sum(2                              | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub>           | 185.87<br>206.75<br>=<br>0                | 0<br>kWh/ye<br>963.78 | (206)<br>(208)<br>ear<br>(211)<br>(211)<br>(211) |
| (211)m<br>(211)m<br>= {[(98);<br>(215)m=<br>Water H<br>Output<br>Efficien<br>(217)m=<br>Fuel for   | Jan       Fet         heating requ         179.51       140.2         = {[(98)m x (i         199.67       156.0         heating fuel         m x (201)] } x         0       0         heating fuel         m x (201)] } x         0       0         heating fuel         134.98       118.3         cy of water here  | dary/suppl<br>dary/suppl<br>irement (c<br>114.92<br>204)] } x ^<br>1 127.83<br>(secondar<br>100 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0<br>200 ÷ (20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20<br>0)<br>(20)<br>(2  | ementar         Apr         calculate         60.22         100 ÷ (20         66.98         ry), kWh/         0         culated a         108.29         87.82         onth | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month<br>0<br>0<br>bove)<br>104.74 | Jun       0       0       0       0       91.59 | Jul       0       0       0       86.07 | 0<br>Tota<br>0<br>Tota<br>97.06         | 0<br>I (kWh/yea<br>0<br>I (kWh/yea<br>97.71 | 48.32<br>53.75<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>112.39                    | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>121.25 | 185.87<br>206.75<br>=<br>0<br>=<br>131.09 | 0<br>kWh/ye<br>963.78 | (211)<br>(211)<br>(215)<br>(216)                 |
| (211)m<br>(211)m<br>= {[(98);<br>(215)m=<br>Water H<br>Output<br>Efficien<br>(217)m=<br>Fuel for   | Jan       Fet         heating requ         179.51       140.2         = {[(98)m x (100)         199.67       156.0         heating fuel         m x (201)] } x         0       0         heating fuel         m x (201)] } x         0       0         heating fuel         m x (201)] } x         0       0         heating fuel         134.98       118.3         cy of water heatin         88.5       88.41         water heatin         = (64)m x 1 | dary/suppl<br>irement (<br>114.92<br>204)] } x ^<br>1 127.83<br>(secondar<br>100 ÷ (20<br>0<br>204)] 0<br>204)] } x ^<br>1 127.83<br>(secondar<br>100 ÷ (20<br>0<br>204)] 8<br>204)] ementar         Apr         calculate         60.22         100 ÷ (20         66.98         ry), kWh/         0         culated a         108.29         87.82         onth | y heating<br>May<br>d above)<br>19.8<br>06)<br>22.03<br>month<br>0<br>0<br>bove)<br>104.74 | Jun       0       0       0       0       91.59 | Jul       0       0       0       86.07 | 0<br>Tota<br>0<br>Tota<br>97.06<br>86.7 | 0<br>I (kWh/yea<br>0<br>I (kWh/yea<br>97.71 | 48.32<br>53.75<br>ar) =Sum(2<br>0<br>ar) =Sum(2<br>112.39<br>87.64<br>128.25 | 117.54<br>130.75<br>211) <sub>15,1012</sub><br>0<br>215) <sub>15,1012</sub><br>121.25 | 185.87<br>206.75<br>=<br>0<br>=<br>131.09 | 0<br>kWh/ye<br>963.78 | (211)<br>(211)<br>(215)<br>(216)                 |

| Annual totals                                    |                              | kWh/year                             | kWh/year                        |
|--|------------------------------|--------------------------------------|---------------------------------|
| Space heating fuel used, main system 1           |                              |                                      | 963.78                          |
| Water heating fuel used                          |                              |                                      | 1512.5                          |
| Electricity for pumps, fans and electric keep-ho | t                            |                                      |                                 |
| mechanical ventilation - balanced, extract or p  | oositive input from outside  | 121                                  | .42 (230a)                      |
| central heating pump:                            |                              | 3                                    | 0 (230c)                        |
| boiler with a fan-assisted flue                  |                              | 4                                    | 5 (230e)                        |
| Total electricity for the above, kWh/year        | sum of (                     | 230a)(230g) =                        | 196.42 (231)                    |
| Electricity for lighting                         |                              |                                      | 318.91 (232)                    |
| 12a. CO2 emissions – Individual heating syste    | ems including micro-CHP      |                                      |                                 |
|  | <b>Energy</b><br>kWh/year    | <b>Emission factor</b><br>kg CO2/kWh | <b>Emissions</b><br>kg CO2/year |
| Space heating (main system 1)                    | (211) x                      | 0.216 =                              | 208.18 (261)                    |
| Space heating (secondary)                        | (215) x                      | 0.519 =                              | 0 (263)                         |
| Water heating                                    | (219) x                      | 0.216 =                              | 326.7 (264)                     |
| Space and water heating                          | (261) + (262) + (263) + (264 | ) =                                  | 534.88 (265)                    |

(231) x

(232) x

0.519

0.519

sum of (265)...(271) :

(272) ÷ (4) =

101.94

165.52

802.33

15.52

89

(267)

(268)

(272)

(273)

(274)

Electricity for pumps, fans and electric keep-hot

Electricity for lighting

Total CO2, kg/year

El rating (section 14)

Dwelling CO2 Emission Rate

|   |                             |                         | User D                                | etails:                      |             |                 |                       |          |  |      |
|---|-----------------------------|-------------------------|---------------------------------------|------------------------------|-------------|-----------------|-----------------------|----------|--|------|
| Assessor Name:<br>Software Name:                              | Stroma FSAP 201             |                         |                                       | Stroma<br>Softwa<br>Address: | re Ver      |                 |                       | Versio   | n: 1.0.4.23                            |      |
| Address :   | 2 Bed Flat, 219-223         |                         |                                       |                              |             | nh lunct        | ion I ON              |          |  |      |
| 1. Overall dwelling dimer                                     |                             | Columan                 |                                       | ne, Loug                     | προιοαί     | gri Junci       |                       |          |  |      |
| Ground floor  |                             |                         | Area<br>8                             |                              | (1a) x      | <b>Av. He</b>   | <b>ight(m)</b><br>2.5 | (2a) =   | <b>Volume(m<sup>3</sup>)</b><br>211.75 | (3a) |
| Total floor area TFA = (1a                                    | )+(1b)+(1c)+(1d)+(1e        | )+(1n)                  | 8                                     | 4.7                          | (4)         |                 |                       |          |  |      |
| Dwelling volume   |                             |                         |                                       |                              | (3a)+(3b)   | +(3c)+(3d       | l)+(3e)+              | .(3n) =  | 211.75                                 | (5)  |
| 2. Ventilation rate:  |                             |                         |                                       |                              |             |                 |                       |          |  |      |
| Number of chimneys  |                             | econdary<br>eating<br>0 | , , , , , , , , , , , , , , , , , , , | other<br>0                   | ] = [       | <b>total</b>    | × 4                   | 40 =     | m <sup>3</sup> per hour                | (6a) |
| Number of open flues  | 0 +                         | 0                       | ] + [                                 | 0                            | ] = [       | 0               | x 2                   | 20 =     | 0                                      | (6b) |
| Number of intermittent fan                                    | s                           |                         | J L_                                  |                              |             | 0               | x 1                   | 10 =     | 0                                      | (7a) |
| Number of passive vents                                       |                             |                         |                                       |                              | Ē           | 0               | x 1                   | 10 =     | 0                                      | (7b) |
| Number of flueless gas fire                                   | es                          |                         |                                       |                              |             | 0               | x 4                   | 40 =     | 0                                      | (7c) |
|   |                             |                         |                                       |                              |             |                 |                       | Air ch   | ange <mark>s per</mark> ho             | ur   |
| Infiltration due to chimney                                   |                             |                         |                                       |                              | Ę           | 0               |                       | ÷ (5) =  | 0                                      | (8)  |
| If a pressurisation test has be<br>Number of storeys in the   |                             | ed, proceed             | to (17), o                            | otherwise c                  | ontinue fro | om (9) to (     |                       |          | 0                                      | (9)  |
| Additional infiltration                                       | ) – fan ete el en timb en f |                         | 0.05 (                                |                              |             |                 | [(9)-                 | 1]x0.1 = | 0                                      | (10) |
| Structural infiltration: 0.2<br>if both types of wall are pre | sent, use the value corres  |                         |                                       |                              | •           | uction          |                       | l        | 0                                      | (11) |
| deducting areas of opening                                    |                             | ed) or 0.1              | l (seale                              | d), else                     | enter 0     |                 |                       | [        | 0                                      | (12) |
| If no draught lobby, ente                                     | er 0.05, else enter 0       |                         |                                       |                              |             |                 |                       |          | 0                                      | (13) |
| Percentage of windows   | and doors draught st        | ripped                  |                                       |                              |             |                 |                       |          | 0                                      | (14) |
| Window infiltration   |                             |                         | (                                     | 0.25 - [0.2                  | x (14) ÷ 1  | = [00           |                       |          | 0                                      | (15) |
| Infiltration rate   |                             |                         |                                       | (8) + (10) -                 |             |                 |                       |          | 0                                      | (16) |
| Air permeability value, c                                     |                             |                         | •                                     | •                            |             | etre of e       | nvelope               | area     | 2                                      | (17) |
| If based on air permeabilit                                   | -                           |                         |                                       |                              |             | :- <b>b</b> - : |                       |          | 0.1                                    | (18) |
| Air permeability value applies<br>Number of sides sheltered   |                             | i been done             | e or a deg                            | ree all per                  | meability   | is being us     | seu                   | I        | 0                                      | (19) |
| Shelter factor  |                             |                         |                                       | (20) = 1 - [                 | 0.075 x (1  | 9)] =           |                       |          | 1                                      | (20) |
| Infiltration rate incorporation                               | ng shelter factor           |                         |                                       | (21) = (18)                  | x (20) =    |                 |                       |          | 0.1                                    | (21) |
| Infiltration rate modified fo                                 | r monthly wind speed        |                         |                                       |                              |             |                 |                       | I        |  |      |
| Jan Feb M   | /lar Apr May                | Jun                     | Jul                                   | Aug                          | Sep         | Oct             | Nov                   | Dec      |  |      |
| Monthly average wind spe                                      | ed from Table 7             |                         |                                       |                              |             |                 |                       |          |  |      |
| (22)m= 5.1 5 4  | .9 4.4 4.3                  | 3.8                     | 3.8                                   | 3.7                          | 4           | 4.3             | 4.5                   | 4.7      |  |      |
| Wind Factor (22a)m = (22                                      | )m ÷ 4                      |                         |                                       |                              |             |                 |                       |          |  |      |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08                | 0.95                    | 0.95                                  | 0.92                         | 1           | 1.08            | 1.12                  | 1.18     |  |      |

| Adjuste  | ed infiltra            | ation rat                       | e (allow   | ing for sl                  | nelter an    | d wind s       | peed) =            | = (21a) x      | (22a)m       |                   |                       |                   |              |               |
|----------|------------------------|---------------------------------|------------|-----------------------------|--------------|----------------|--------------------|----------------|--------------|-------------------|-----------------------|-------------------|--------------|---------------|
|          | 0.13                   | 0.12                            | 0.12       | 0.11                        | 0.11         | 0.1            | 0.1                | 0.09           | 0.1          | 0.11              | 0.11                  | 0.12              |              |               |
|          |                        | c <i>tive air</i><br>al ventila | -          | rate for t                  | he appli     | cable ca       | se                 |                |              |                   |                       |                   |              | - (220)       |
|          |                        |                                 |            | endix N (2                  | (23a) = (23a | a) x Emv (e    | equation (         | N5)), othe     | rwise (23h   | (23a) = (23a)     |                       |                   | 0.8          |               |
|          |                        | • •                             | 0 11       | . (                         | , (          | , ,            |                    | m Table 4h     | ,            | <i>,)</i> = (200) |                       |                   | 0.8          |               |
|          |                        |                                 |            |                             | Ū            |                | ,                  | HR) (24a       | ,            | 2h)m + ('         | 23h) v [ <sup>.</sup> | 1 – (23c)         | 73.          | 1 (230)       |
| (24a)m=  |                        | 0.26                            | 0.26       | 0.24                        | 0.24         | 0.23           | 0.23               | 0.23           | 0.23         | 0.24              | 0.25                  | 0.25              | ]<br>]       | (24a)         |
| · · ·    |                        |                                 |            |                             |              |                |                    | MV) (24b       |              |                   |                       |                   | J            |               |
| (24b)m=  | 0                      | 0                               | 0          | 0                           | 0            | 0              | 0                  | 0              | 0            | 0                 | 0                     | 0                 | 1            | (24b)         |
| · · ·    | whole h                | use ex                          | tract ver  | ntilation of                | r positiv    | input v        | ı<br>ventilati     | on from o      | L<br>outside |                   |                       |                   | J            |               |
| ,        |                        |                                 |            |                             | •            | •              |                    | lc) = (22k     |              | .5 × (23b         | )                     |                   |              |               |
| (24c)m=  | 0                      | 0                               | 0          | 0                           | 0            | 0              | 0                  | 0              | 0            | 0                 | 0                     | 0                 | ]            | (24c)         |
| ,        |                        |                                 |            |                             | •            | •              |                    | on from I      |              | _                 |                       |                   | -            |               |
|          | · ·                    | ,                               | r <u>`</u> | r È                         | ŕ            | , `            | , <u> </u>         | 0.5 + [(2      | r            | <u> </u>          |                       | <u> </u>          | 1            |               |
| (24d)m=  |                        | 0                               | 0          | 0                           | 0            | 0              | 0                  | 0              | 0            | 0                 | 0                     | 0                 |              | (24d)         |
|          |                        |                                 | î .        | <u> </u>                    | í .          | ŕ              | , <u>,</u>         | 1d) in box     | 1 /          | 0.04              | 0.05                  | 0.05              | 1            | (05)          |
| (25)m=   | 0.26                   | 0.26                            | 0.26       | 0.24                        | 0.24         | 0.23           | 0.23               | 0.23           | 0.23         | 0.24              | 0.25                  | 0.25              | J            | (25)          |
| 3. Hea   | at l <mark>osse</mark> | s and he                        | eat loss   | paramet                     | er:          |                |                    |                |              |                   |                       |                   |              |               |
| ELEN     |                        | Gros<br>area                    |            | Openin<br>m                 |              | Net Ar<br>A ,r |                    | U-valı<br>W/m2 |              | A X U<br>(W/ł     | <)                    | k-value<br>kJ/m²· |              | A X k<br>kJ/K |
| Window   | ws Type                | e 1                             |            |                             |              | 8.91           | x1                 | /[1/( 0.73 )-  | + 0.04] =    | 6.32              |                       |                   |              | (27)          |
| Windov   | ws Type                | 2                               |            |                             |              | 1.28           | X                  | /[1/( 0.73 )-  | + 0.04] =    | 0.91              |                       |                   |              | (27)          |
| Windov   | ws Type                | 93                              |            |                             |              | 11.02          | 5 <mark>x</mark> 1 | /[1/( 0.73 )-  | + 0.04] =    | 7.82              |                       |                   |              | (27)          |
| Windov   | ws Type                | e 4                             |            |                             |              | 7.2            | اx                 | /[1/( 0.73 )-  | + 0.04] =    | 5.11              |                       |                   |              | (27)          |
| Window   | ws Type                | e 5                             |            |                             |              | 3.15           | ۲x                 | /[1/( 0.73 )-  | + 0.04] =    | 2.23              |                       |                   |              | (27)          |
| Walls 7  | Гуре1                  | 27                              | ,          | 8.91                        |              | 18.09          | ) x                | 0.15           | =            | 2.71              | ] [                   |                   |              | (29)          |
| Walls 7  | Гуре2                  | 32.                             | 5          | 1.28                        | 3            | 31.22          | <u>x</u>           | 0.15           | =            | 4.68              | ז ר                   |                   | = F          | (29)          |
| Walls 7  | ГуреЗ                  | 14.                             | 5          | 11.0                        | 2            | 3.48           | x                  | 0.15           | =            | 0.52              | ז ר                   |                   | = F          | (29)          |
| Walls 7  | Гуре4                  | 22                              | 2          | 3.15                        | 5            | 18.85          | 5 X                | 0.15           | =            | 2.83              | i F                   |                   | ΞĒ           | (29)          |
| Walls 7  | Гуре5                  | 9                               |            | 7.2                         |              | 1.8            | x                  | 0.15           |              | 0.27              | i F                   |                   | ΞĒ           | (29)          |
| Roof     |                        | 84.                             | 7          | 0                           |              | 84.7           | x                  | 0.11           |              | 9.32              | i F                   |                   | ΞĒ           | (30)          |
| Total a  | rea of e               | lements                         | s, m²      |                             |              | 189.7          | ,                  |                |              |                   |                       |                   |              | (31)          |
| Party v  | vall                   |                                 |            |                             |              | 17.5           | ×                  | 0              | =            | 0                 |                       |                   |              | (32)          |
| Party fl | loor                   |                                 |            |                             |              | 84.7           |                    | L              | 1            |                   |                       |                   |              | (32a)         |
| -        | ıl wall **             |                                 |            |                             | 126.5        |                |                    |                |              | L<br>[            |                       | $\dashv$          | (32c)        |               |
|          |                        |                                 |            | effective wi<br>nternal wal |              | alue calcul    |                    | g formula 1    | /[(1/U-valı  | ue)+0.04] a       | L<br>Is given in      | paragrapl         | ш Ц<br>h 3.2 |               |

| Fabric heat loss, $W/K = S (A \times U)$                             | (26)(30) + (32) =               | 42.72   | (33) |
|--|---------------------------------|---------|------|
| Heat capacity $Cm = S(A \times k)$                                   | ((28)(30) + (32) + (32a)(32e) = | 14177.7 | (34) |
| Thermal mass parameter (TMP = $Cm \div TFA$ ) in kJ/m <sup>2</sup> K | Indicative Value: Medium        | 250     | (35) |
|  |                                 |         |      |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

| can be u   | used inste | ad of a de            | tailed calc | ulation.    |             |             |            |             |            |                        |                        |          |         |      |
|------------|------------|-----------------------|-------------|-------------|-------------|-------------|------------|-------------|------------|------------------------|------------------------|----------|---------|------|
| Therm      | al bridg   | es : S (L             | x Y) cal    | culated u   | using Ap    | pendix ł    | <          |             |            |                        |                        |          | 15.63   | (36) |
| if details | of therma  | al bridging           | are not kn  | own (36) =  | = 0.05 x (3 | 1)          |            |             |            |                        |                        |          |         |      |
| Total f    | abric he   | at loss               |             |             |             |             |            |             | (33) +     | (36) =                 |                        |          | 58.35   | (37) |
| Ventila    | tion hea   | at loss ca            | alculated   | monthl      | ý           |             | -          |             | (38)m      | = 0.33 × (             | 25)m x (5)             |          |         |      |
|            | Jan        | Feb                   | Mar         | Apr         | May         | Jun         | Jul        | Aug         | Sep        | Oct                    | Nov                    | Dec      |         |      |
| (38)m=     | 18.31      | 18.13                 | 17.96       | 17.09       | 16.91       | 16.04       | 16.04      | 15.86       | 16.39      | 16.91                  | 17.26                  | 17.61    |         | (38) |
| Heat ti    | ansfer o   | coefficier            | nt, W/K     |             |             |             |            |             | (39)m      | = (37) + (3            | 38)m                   |          |         |      |
| (39)m=     | 76.66      | 76.49                 | 76.31       | 75.44       | 75.26       | 74.39       | 74.39      | 74.22       | 74.74      | 75.26                  | 75.61                  | 75.96    |         |      |
|            |            | motor (L              | יאי ים ור   | /m21/       |             |             |            |             |            | Average =<br>= (39)m ÷ | Sum(39) <sub>1.</sub>  | .12 /12= | 75.4    | (39) |
|            | 0.91       | meter (H              | 0.9         | i           | 0.89        | 0.99        | 0.88       | 0.88        |            | = (39)III ÷            |                        | 0.0      |         |      |
| (40)m=     | 0.91       | 0.9                   | 0.9         | 0.89        | 0.89        | 0.88        | 0.88       | 0.88        | 0.88       |                        | 0.89                   | 0.9      | 0.00    |      |
| Numbe      | er of day  | /s in moi             | nth (Tab    | le 1a)      |             |             |            |             | ,          | Average =              | Sum(40)₁               | .12/12=  | 0.89    | (40) |
|            | Jan        | Feb                   | Mar         | Apr         | May         | Jun         | Jul        | Aug         | Sep        | Oct                    | Nov                    | Dec      |         |      |
| (41)m=     | 31         | 28                    | 31          | 30          | 31          | 30          | 31         | 31          | 30         | 31                     | 30                     | 31       |         | (41) |
|            |            |                       |             |             |             |             |            |             |            |                        |                        |          |         |      |
| 4. Wa      | ater hea   | ting ener             | rav reau    | irement:    |             |             |            |             |            |                        |                        | kWh/ye   | ear:    |      |
|            |            |                       |             |             |             |             |            |             |            |                        |                        |          |         |      |
|            |            | ipancy, I             |             | [1 ovp      | ( 0 0003    |             | - 120      | )2)] + 0.0  | 012 v (*   | TEA 12                 | 2.                     | 55       |         | (42) |
|            | A £ 13.    |                       | + 1.70 X    | [i - exp    | (-0.0003    | 949 X (11   | -A - 13.9  | )2)] + 0.0  | 013 X (    | IFA -13.               | .9)                    |          |         |      |
|            |            |                       | ater usag   | ge in litre | es per da   | y Vd,av     | erage =    | (25 x N)    | + 36       |                        | 94                     | .67      |         | (43) |
|            |            |                       |             |             |             | -           | 7          | to achieve  | a water us | se target o            | f                      |          |         |      |
| notmore    |            | litres per p          | berson per  | day (all w  | aler use, r | iot and col |            |             |            |                        |                        |          |         |      |
|            | Jan        | Feb                   | Mar         | Apr         | May         | Jun         | Jul        | Aug         | Sep        | Oct                    | Nov                    | Dec      |         |      |
| Hot wat    | er usage i | n litres per          | day for ea  | ach month   | Vd,m = fai  | ctor from I | able 1c x  | (43)        |            |                        |                        |          |         |      |
| (44)m=     | 104.13     | 100.35                | 96.56       | 92.77       | 88.99       | 85.2        | 85.2       | 88.99       | 92.77      | 96.56                  | 100.35                 | 104.13   |         | _    |
| Enorm      | contont of | botwator              | upod ool    | aulated m   | opthly - 1  | 100 v Vd r  | л v nm v Г | Tm / 2600   |            |                        | $m(44)_{112} =$        |          | 1136.02 | (44) |
|            |            |                       |             |             |             |             |            | )Tm / 3600  |            |                        |                        |          | I       |      |
| (45)m=     | 154.43     | 135.06                | 139.37      | 121.51      | 116.59      | 100.61      | 93.23      | 106.98      | 108.26     | 126.17                 | 137.72                 | 149.56   |         |      |
| lf instan  | taneous w  | vater heatii          | ng at point | of use (no  | hot water   | ·storage).  | enter 0 in | boxes (46)  |            | l otal = Su            | m(45) <sub>112</sub> = |          | 1489.5  | (45) |
| (46)m=     | 23.16      | 20.26                 | 20.91       | 18.23       | 17.49       | 15.09       | 13.98      | 16.05       | 16.24      | 18.93                  | 20.66                  | 22.43    |         | (46) |
|            | storage    |                       | 20.91       | 10.25       | 17.45       | 15.05       | 15.50      | 10.05       | 10.24      | 10.95                  | 20.00                  | 22.43    |         | (40) |
|            | -          |                       | includir    | ng any so   | olar or W   | /WHRS       | storage    | within sa   | me ves     | sel                    |                        | )        |         | (47) |
| If com     | munity h   | eating a              | ind no ta   | ınk in dw   | velling, e  | nter 110    | litres in  | (47)        |            |                        | •                      |          |         |      |
| Otherv     | vise if no | o stored              | hot wate    | er (this in | icludes i   | nstantar    | neous co   | mbi boil    | ers) ente  | ər '0' in (            | 47)                    |          |         |      |
|            | storage    |                       |             |             |             |             |            |             |            |                        |                        |          |         |      |
| a) If m    | nanufact   | urer's de             | eclared I   | oss facto   | or is kno   | wn (kWł     | n/day):    |             |            |                        | (                      | )        |         | (48) |
| Tempe      | erature f  | actor fro             | m Table     | 2b          |             |             |            |             |            |                        | (                      | )        |         | (49) |
|            |            | m water               | -           |             |             |             |            | (48) x (49) | =          |                        | (                      | )        |         | (50) |
| ,          |            | urer's de<br>age loss |             |             |             |             |            |             |            |                        |                        |          | l       | (51) |
|            |            | leating s             |             |             |             | -/ III C/Ud | ·y)        |             |            |                        |                        | )        |         | (51) |
|            | •          | from Tal              |             |             |             |             |            |             |            |                        | (                      | )        |         | (52) |
| Tempe      | erature f  | actor fro             | m Table     | 2b          |             |             |            |             |            |                        |                        | )        |         | (53) |

| •              |           | m water<br>(54) in (5                 | -         | , kWh/ye   | ear        |                                       |             | (47) x (51)                           | ) x (52) x (             | 53) =                     |             | 0           |                   | (54)<br>(55) |
|----------------|-----------|---------------------------------------|-----------|------------|------------|---------------------------------------|-------------|---------------------------------------|--------------------------|---------------------------|-------------|-------------|-------------------|--------------|
|                | . ,       | . , .                                 |           | for each   | month      |                                       |             | ((56)m = (                            | 55) × (41)r              | n                         |             | •           | I                 | ()           |
| (56)m=         | 0         | 0                                     | 0         | 0          | 0          | 0                                     | 0           | 0                                     | 0                        | 0                         | 0           | 0           | ]                 | (56)         |
|                | -         | -                                     | -         | -          | -          | -                                     |             | -                                     | 7)m = (56)               | m where (                 | -           | -           | <b>J</b><br>lix H |              |
| (57)m=         | 0         | 0                                     | 0         | 0          | 0          | 0                                     | 0           | 0                                     | 0                        | 0                         | 0           | 0           |                   | (57)         |
| Prima          | y circuit | loss (ar                              | nual) fro | om Table   | e 3        |                                       | -           |                                       |                          |                           |             | 0           |                   | (58)         |
| Primar         | y circuit | loss cal                              | culated   | for each   | month (    | 59)m = (                              | (58) ÷ 36   | 65 × (41)                             | m                        |                           |             |             |                   |              |
| (mo            | dified by | factor f                              | rom Tab   | le H5 if t | here is s  | solar wat                             | er heatii   | ng and a                              | ı cylinde                | r thermo                  | stat)       |             | 1                 |              |
| (59)m=         | 0         | 0                                     | 0         | 0          | 0          | 0                                     | 0           | 0                                     | 0                        | 0                         | 0           | 0           |                   | (59)         |
| Combi          | loss ca   | lculated                              | for each  | month      | (61)m =    | (60) ÷ 36                             | 65 × (41)   | )m                                    |                          |                           | -           | -           |                   |              |
| (61)m=         | 11.85     | 10.69                                 | 11.82     | 11.41      | 11.77      | 11.37                                 | 11.74       | 11.76                                 | 11.39                    | 11.8                      | 11.45       | 11.84       |                   | (61)         |
| Total h        | neat req  | uired for                             | water h   | eating ca  | alculated  | for eac                               | h month     | (62)m =                               | 0.85 × (                 | 45)m +                    | (46)m +     | (57)m +     | (59)m + (61)r     | n            |
| (62)m=         | 166.28    | 145.76                                | 151.19    | 132.92     | 128.36     | 111.98                                | 104.96      | 118.74                                | 119.65                   | 137.97                    | 149.17      | 161.4       |                   | (62)         |
| Solar DI       | HW input  | calculated                            | using App | endix G o  | r Appendix | : H (negati                           | ve quantity | /) (enter '0                          | ' if no sola             | r contribut               | ion to wate | er heating) |                   |              |
| (add a         | dditiona  | l lines if                            | FGHRS     | and/or \   | NWHRS      | applies                               | , see Ap    | pendix (                              | G)                       |                           |             |             | 1                 |              |
| (63)m=         | 0         | 0                                     | 0         | 0          | 0          | 0                                     | 0           | 0                                     | 0                        | 0                         | 0           | 0           |                   | (63)         |
| Outpu          | t from w  | ater hea                              | ter       |            |            |                                       |             |                                       |                          |                           |             |             | 1                 |              |
| (64)m=         | 166.28    | 145.76                                | 151.19    | 132.92     | 128.36     | 111.98                                | 104.96      | 118.74                                | 119.65                   | 137.97                    | 149.17      | 161.4       |                   | _            |
|                |           |                                       |           |            |            |                                       |             |                                       | out from wa              |                           |             |             | 1628.38           | (64)         |
| Heat g         | ains fro  | m water                               | heating.  | kWh/m      | onth 0.2   | 5 ⁄ [0.85                             | × (45)m     | 1 + (61)m                             | ו <mark>] + 0.8 x</mark> | : [(46)m                  | + (57)m     | + (59)m     | ]                 |              |
| (65)m=         | 54.31     | 47.58                                 | 49.3      | 43.25      | 41.71      | 36.3                                  | 33.93       | 38.51                                 | 38.84                    | 44.9                      | 48.65       | 52.69       |                   | (65)         |
| inclu          | ude (57)  | m in calo                             | culation  | of (65)m   | only if c  | ylinder i                             | s in the o  | dwelling                              | or hot w                 | ate <mark>r is f</mark> r | om com      | munity h    | eating            |              |
| <b>5.</b> In   | ternal ga | ains (see                             | e Table 5 | 5 and 5a   | ):         |                                       |             |                                       |                          |                           |             |             |                   |              |
| Metab          | olic gair | s (Table                              | 5), Wat   | ts         |            |                                       |             |                                       |                          |                           |             |             |                   |              |
|                | Jan       | Feb                                   | Mar       | Apr        | May        | Jun                                   | Jul         | Aug                                   | Sep                      | Oct                       | Nov         | Dec         |                   |              |
| (66)m=         | 127.3     | 127.3                                 | 127.3     | 127.3      | 127.3      | 127.3                                 | 127.3       | 127.3                                 | 127.3                    | 127.3                     | 127.3       | 127.3       |                   | (66)         |
| Lightin        | <u> </u>  | ` <u> </u>                            | · · · · · | ·          | · ·        | ion L9 o                              | ,.<br>I     | · · · · · · · · · · · · · · · · · · · |                          |                           |             | 1           | 1                 |              |
| (67)m=         | 26.77     | 23.78                                 | 19.34     | 14.64      | 10.94      | 9.24                                  | 9.98        | 12.98                                 | 17.42                    | 22.12                     | 25.81       | 27.52       |                   | (67)         |
| •••            |           | · · · · · · · · · · · · · · · · · · · | ı —       | · · ·      | · · ·      |                                       | 1           | · ·                                   | see Tal                  |                           | 1           | 1           | 1                 |              |
| (68)m=         | 228.98    | 231.36                                | 225.37    | 212.62     | 196.53     | 181.41                                | 171.31      | 168.93                                | 174.92                   | 187.66                    | 203.76      | 218.88      |                   | (68)         |
| Cookir         |           | <u>`</u>                              |           |            | · · ·      | · · · · · · · · · · · · · · · · · · · | ,<br>       | ), also se                            | e Table                  | 5                         |             |             | 1                 |              |
| (69)m=         | 35.73     | 35.73                                 | 35.73     | 35.73      | 35.73      | 35.73                                 | 35.73       | 35.73                                 | 35.73                    | 35.73                     | 35.73       | 35.73       |                   | (69)         |
| Pumps          | s and fai | ns gains                              | (Table \$ | ōa)        | i          | i                                     | i           | i                                     |                          |                           | i           | i           | 1                 |              |
| (70)m=         | 3         | 3                                     | 3         | 3          | 3          | 3                                     | 3           | 3                                     | 3                        | 3                         | 3           | 3           |                   | (70)         |
| Losse          | s e.g. ev | aporatic                              | n (nega   | tive valu  | es) (Tab   | ole 5)                                |             |                                       |                          |                           |             |             |                   |              |
| (71)m=         | -101.84   | -101.84                               | -101.84   | -101.84    | -101.84    | -101.84                               | -101.84     | -101.84                               | -101.84                  | -101.84                   | -101.84     | -101.84     |                   | (71)         |
| Water          | heating   | gains (T                              | able 5)   |            |            |                                       |             |                                       |                          |                           | -           |             |                   |              |
| (72)m=         | 73        | 70.81                                 | 66.26     | 60.08      | 56.06      | 50.41                                 | 45.61       | 51.76                                 | 53.95                    | 60.35                     | 67.58       | 70.82       |                   | (72)         |
| <b>Total</b> i | internal  | gains =                               |           |            |            | (66)                                  | m + (67)m   | n + (68)m +                           | + (69)m + (              | 70)m + (7                 | 1)m + (72)  | )m          |                   |              |
| (73)m=         | 392.94    | 390.14                                | 375.16    | 351.53     | 327.73     | 305.25                                | 291.09      | 297.86                                | 310.48                   | 334.32                    | 361.34      | 381.41      |                   | (73)         |
| 6. So          | lar gains | S:                                    |           |            |            |                                       |             |                                       |                          |                           |             |             |                   |              |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation:  | Access Facto<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a     |   | g_<br>Table 6b |   | FF<br>Table 6c |     | Gains<br>(W) |      |
|---------------|--------------------------|---|------------|---|----------------------|---|----------------|---|----------------|-----|--------------|------|
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 11.28                | × | 0.63           | x | 0.1            | ] = | 0.63         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 22.97                | x | 0.63           | x | 0.1            | =   | 1.28         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 41.38                | × | 0.63           | x | 0.1            | =   | 2.31         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 67.96                | x | 0.63           | x | 0.1            | =   | 3.8          | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 91.35                | x | 0.63           | x | 0.1            | =   | 5.1          | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 97.38                | × | 0.63           | x | 0.1            | =   | 5.44         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 91.1                 | × | 0.63           | x | 0.1            | =   | 5.09         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 72.63                | x | 0.63           | x | 0.1            | =   | 4.06         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 50.42                | x | 0.63           | x | 0.1            | =   | 2.82         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 28.07                | x | 0.63           | x | 0.1            | =   | 1.57         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 14.2                 | × | 0.63           | x | 0.1            | ] = | 0.79         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 9.21                 | x | 0.63           | x | 0.1            | =   | 0.51         | (75) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 36.79                | x | 0.63           | x | 0.1            | =   | 5.06         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 62.67                | x | 0.63           | x | 0.1            | =   | 8.62         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 85.75                | × | 0.63           | x | 0.1            | =   | 11.79        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | × | 106.25               | x | 0.63           | х | 0.1            | =   | 14.61        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 119.01               | x | 0.63           | x | 0.1            | ] = | 16.37        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | х | 118.15               | × | 0.63           | x | 0.1            | =   | 16.25        | (77) |
| Southeast 0.9 | ( 0.7 <mark>7</mark>     | x | 3.15       | x | 113.91               | x | 0.63           | x | 0.1            | =   | 15.67        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 104.3 <mark>9</mark> | x | 0.63           | x | 0.1            | =   | 14.36        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 92.85                | × | 0.63           | x | 0.1            | =   | 12.77        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 69.27                | x | 0.63           | x | 0.1            | =   | 9.53         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 44.07                | × | 0.63           | x | 0.1            | =   | 6.06         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 31.49                | x | 0.63           | x | 0.1            | =   | 4.33         | (77) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 36.79                |   | 0.63           | x | 0.1            | =   | 14.31        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 62.67                |   | 0.63           | x | 0.1            | =   | 24.38        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 85.75                |   | 0.63           | x | 0.1            | =   | 33.36        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 106.25               |   | 0.63           | x | 0.1            | =   | 41.33        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 119.01               |   | 0.63           | x | 0.1            | =   | 46.3         | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 118.15               |   | 0.63           | x | 0.1            | =   | 45.96        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 113.91               |   | 0.63           | x | 0.1            | =   | 44.31        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 104.39               |   | 0.63           | x | 0.1            | =   | 40.61        | (79) |
| Southwest0.9  | ••••                     | x | 8.91       | x | 92.85                |   | 0.63           | x | 0.1            | =   | 36.12        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 69.27                |   | 0.63           | x | 0.1            | =   | 26.95        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 44.07                |   | 0.63           | x | 0.1            | =   | 17.14        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 31.49                |   | 0.63           | x | 0.1            | =   | 12.25        | (79) |
| West 0.9      | 0.77                     | x | 7.2        | x | 19.64                | × | 0.63           | x | 0.1            | =   | 6.17         | (80) |
| West 0.9      | 0.77                     | x | 7.2        | x | 38.42                | × | 0.63           | x | 0.1            | =   | 12.08        | (80) |
| West 0.9      | 0.77                     | x | 7.2        | x | 63.27                | x | 0.63           | x | 0.1            | =   | 19.89        | (80) |

| West 0 9x   |  | <b>_</b>   |  | ٦   |  | ٦   |   | ٦   |   |   |       |  |
|---|--|--|--|---|--|---|---|---|---|---|-------|--|
| 0.07  | 0.77   | ×  | 7.2  | ×<br>   | 92.28  | X<br>T  | 0.63  | ×   | 0.1   | =   | 29.01 | (80)   |
|   | 0.77   | ×  | 7.2  | ] ×<br>1  | 113.09   | X<br>T  | 0.63  | ×   | 0.1   | =   | 35.55 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ] ×<br>T  | 115.77   | X<br>T  | 0.63  | ×   | 0.1   | =   | 36.39 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ] ×   | 110.22   | X   | 0.63  | ×   | 0.1   | =   | 34.65 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ×   | 94.68  | X   | 0.63  | ×   | 0.1   | =   | 29.76 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ×   | 73.59  | X   | 0.63  | ×   | 0.1   | =   | 23.13 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ×   | 45.59  | X   | 0.63  | ×   | 0.1   | =   | 14.33 | (80)   |
| West 0.9x   | 0.77   | x  | 7.2  | ×   | 24.49  | x   | 0.63  | x   | 0.1   | =   | 7.7   | (80)   |
| West 0.9x   | 0.77   | x  | 7.2  | ×   | 16.15  | x   | 0.63  | x   | 0.1   | =   | 5.08  | (80)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | ×   | 11.28  | x   | 0.63  | x   | 0.1   | =   | 5.43  | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | ×   | 22.97  | x   | 0.63  | x   | 0.1   | =   | 11.05 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 41.38  | x   | 0.63  | x   | 0.1   | =   | 19.92 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | ×   | 67.96  | x   | 0.63  | x   | 0.1   | =   | 32.71 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 91.35  | x   | 0.63  | x   | 0.1   | =   | 43.97 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 97.38  | x   | 0.63  | x   | 0.1   | =   | 46.88 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | ×   | 91.1   | x   | 0.63  | x   | 0.1   | =   | 43.85 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | ×   | 72.63  | x   | 0.63  | x   | 0.1   | =   | 34.96 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | X   | 50.42  | х   | 0.63  | x   | 0.1   | =   | 24.27 | (81)   |
| Northwest 0.9x  | 0.77   | ×  | 11.02  | X   | 28.07  | x   | 0.63  | x   | 0.1   | - 1   | 13.51 | (81)   |
| Nort <mark>hwest</mark> 0.9x  | 0.77   | ×  | 11.02  | x   | 14.2   | Ī×  | 0.63  | x   | 0.1   | =   | 6.83  | (81)   |
| Nort <mark>hwest</mark> 0.9x  | 0.77   | ×  | 11.02  | Īx  | 9.21   | 1 x   | 0.63  | x   | 0.1   | =   | 4.44  | (81)   |
|   |  |  |  |   | 0.21   |   | 0.00  |   | 0.1   |   |       | (  |
|   |  | 7  |  |   | 0.21   | J   | 0.00  |   | 0.1   |   |       |  |
| Solar <u>gains in</u>   | watts, calc  |  |  | th  |  | 4   | n = Sum(74)m  |   | 0.1   |   |       |  |
| Solar gains in<br>(83)m= 31.61  |  |  |  | _   | 50.92 143.56   | 4   | n <del>=</del> Sum(74)m   |   |   | 26.61   |       | (83)   |
|   | 57.41  | ulated   | for each mor<br>121.46 147.2   | 9 1   | 50.92 143.56   | (83)m   | n <del>=</del> Sum(74)m   | (82)m   |   |   |       |  |
| (83)m= 31.61  | 57.41  | ulated   | for each mor<br>121.46 147.2   | 9 1<br>n + (  | 50.92 143.56   | (83)m   | n = Sum(74)m<br>.74 99.11   | (82)m   | 38.53   |   |       |  |
| (83)m= 31.61<br>Total gains – i<br>(84)m= 424.55  | 57.41<br>Internal and<br>447.55  | culated<br>87.27<br>d solar<br>162.43  | for each mon<br>121.46 147.2<br>(84)m = (73)r  | 9 1<br>n + (<br>1 4   | 50.92 143.56<br>83)m , watts   | (83)m<br>123  | n = Sum(74)m<br>.74 99.11   | <br>(82)m<br>65.88  | 38.53   | 26.61   |       | (83)   |
| (83)m= 31.61<br>Total gains –<br>(84)m= 424.55<br>7. Mean inte  | 57.41<br>internal and<br>447.55<br>4   | ulated<br>87.27<br>d solar<br>462.43   | for each mor<br>121.46 147.2<br>(84)m = (73)r<br>472.99 475.0<br>(heating seas   | 9 1<br>n + (<br>1 4<br>on)  | 50.92 143.56<br>83)m , watts   | (83)m<br>123<br>421   | n = Sum(74)m<br>.74 99.11<br>1.6 409.59   | <br>(82)m<br>65.88  | 38.53   | 26.61   | 21    | (83)   |
| (83)m= 31.61<br>Total gains – i<br>(84)m= 424.55<br>7. Mean inte<br>Temperature   | 57.41<br>internal and<br>447.55<br>mal temper<br>during hea  | culated<br>87.27<br>d solar<br>162.43<br>rature (<br>ating po  | for each mor<br>121.46 147.2<br>(84)m = (73)r<br>472.99 475.0<br>(heating seas   | 9 1<br>m + (<br>1 4<br>on)  | 50.92 143.56<br>83)m , watts<br>56.17 434.65<br>area from Ta   | (83)m<br>123<br>421   | n = Sum(74)m<br>.74 99.11<br>1.6 409.59   | <br>(82)m<br>65.88  | 38.53   | 26.61   |       | (83)<br>(84)   |
| (83)m= 31.61<br>Total gains – i<br>(84)m= 424.55<br>7. Mean inte<br>Temperature   | 57.41<br>internal and<br>447.55<br>mal temper<br>during hea  | culated<br>87.27<br>d solar<br>162.43<br>rature (<br>ating po  | for each mon<br>121.46 147.2<br>(84)m = (73)r<br>472.99 475.0<br>(heating sease<br>eriods in the l   | 9 1<br>n + (<br>1 4<br>on)<br>iving<br>,m (s  | 50.92 143.56<br>83)m , watts<br>56.17 434.65<br>area from Ta   | (83)m<br>123<br>421<br>ble 9  | n = Sum(74)m<br>.74 99.11<br>1.6 409.59   | <br>(82)m<br>65.88  | 38.53   | 26.61   |       | (83)<br>(84)   |
| (83)m= 31.61<br>Total gains – i<br>(84)m= 424.55<br>7. Mean inter<br>Temperature<br>Utilisation fac   | 57.41<br>internal and<br>447.55<br>mal temper<br>during hea<br>ctor for gain   | culated<br>87.27<br>d solar<br>462.43<br>rature (<br>ating penns for li  | for each mon           121.46         147.2           (84)m = (73)r           472.99         475.0           (heating sease)           eriods in the leiving area, h1  | 9     1       m + (       1     4       on)       iving       ,m (s       y   | 50.92 143.56<br>83)m , watts<br>56.17 434.65<br>area from Ta<br>ee Table 9a)   | (83)m<br>123<br>421<br>ble 9  | 1 = Sum(74)m<br>.74 99.11<br>1.6 409.59<br>, Th1 (°C)<br>ug Sep   |   | 38.53   | 26.61   |       | (83)<br>(84)   |
| (83)m= 31.61<br>Total gains – i<br>(84)m= 424.55<br>7. Mean inte<br>Temperature<br>Utilisation fac<br>(86)m= 1  | 57.41<br>internal and<br>447.55<br>a during hea<br>ctor for gain<br>Feb<br>1   | Ad solar<br>462.43<br>rature (<br>ating pe<br>ns for li<br>Mar<br>1  | for each mon           121.46         147.2           (84)m = (73)r           472.99         475.0           (heating sease)           eriods in the living area, h1           Apr         Ma           0.99         0.97  | 9 1<br>m + (<br>1 4<br>on)<br>ving<br>,m (s<br>y  | 50.92       143.56         83)m       , watts         56.17       434.65         area from Tal         ee Table 9a)         Jun       Jul         0.88       0.72  | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7  | 1 = Sum(74)m         .74       99.11         1.6       409.59         , Th1 (°C)         ug       Sep         76       0.94   |   | 38.53<br>399.86<br>Nov                        | 26.61<br>408.01<br>Dec                              |       | (83)<br>(84)<br>(85)   |
| (83)m= 31.61<br>Total gains – i<br>(84)m= 424.55<br>7. Mean inte<br>Temperature<br>Utilisation fac<br>(86)m= 1  | 57.41<br>internal and<br>447.55<br>during hea<br>ctor for gain<br>Feb<br>1<br>al temperat  | Ad solar<br>462.43<br>rature (<br>ating pe<br>ns for li<br>Mar<br>1  | for each mon           121.46         147.2           (84)m = (73)r           472.99         475.0           (heating sease)           eriods in the living area, h1           Apr         Ma           0.99         0.97  | 9 1<br>n + (<br>1 4<br>on)<br>iving<br>,m (s<br>y<br>(follc   | 50.92 143.56<br>83)m , watts<br>56.17 434.65<br>area from Tal<br>ee Table 9a)<br>Jun Jul   | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7  | I = Sum(74)m         .74       99.11         I.6       409.59         I.6       409.59         , Th1 (°C)         ug       Sep         76       0.94         Table 9c)  |   | 38.53<br>399.86<br>Nov<br>1                   | 26.61<br>408.01<br>Dec                              |       | (83)<br>(84)<br>(85)   |
| (83)m= 31.61<br>Total gains – i<br>(84)m= 424.55<br>7. Mean inter<br>Temperature<br>Utilisation fac<br>(86)m= 1<br>Mean interna<br>(87)m= 20.01   | 57.41internal and447.55447.55a during headctor for gainFeb1al temperati20.09   | culated<br>87.27<br>d solar<br>462.43<br>rature (<br>ating pe<br>ns for li<br>Mar<br>1<br>ure in l<br>20.25  | for each mon           121         46         147.2 $(84)m = (73)r$ $472.99$ 475.0           472.99         475.0           (heating sease)           eriods in the leving area, h1           Apr         Ma           0.99         0.97           iving area T1         20.48         20.72   | 9       1         m + (         1       4         on)         iving         ,m (s         y         (follo         2       2  | 50.92       143.56         83)m       , watts         56.17       434.65         area from Talee Table 9a)         Jun       Jul         0.88       0.72         ow steps 3 to         20.91       20.98   | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7<br>7 in T<br>20.   | I = Sum(74)m         .74       99.11         I.6       409.59         I.6       409.59         , Th1 (°C)         ug       Sep         76       0.94         Table 9c)         97       20.85   |   | 38.53<br>399.86<br>Nov<br>1                   | 26.61<br>408.01<br>Dec<br>1                         |       | (83)<br>(84)<br>(85)<br>(86)                                 |
| (83)m = 31.61 Total gains – i $(84)m = 424.55$ 7. Mean interverting Temperature Utilisation fac $(86)m = 1$ Mean interva $(87)m = 20.01$ Temperature  | 57.41         internal and         447.55       4         rnal temper         e during heat         ctor for gain         Feb         1         al temperati         20.09         e during heat   | Aulated<br>87.27<br>d solar<br>462.43<br>rature (<br>ating points for ling<br>Mar<br>1<br>ure in l<br>20.25<br>ating points  | for each mon           121.46         147.2           (84)m = (73)r           472.99         475.0           (heating sease           eriods in the I           ving area, h1           Apr         Ma           0.99         0.97           iving area T1         20.48         20.72           eriods in rest         1000 mm  | 9         1           n + (         1           1         4           con)  | 50.92       143.56         83)m       , watts         56.17       434.65         area from Tal         ee Table 9a)         Jun       Jul         0.88       0.72         ow steps 3 to         20.91       20.98         /elling from Tal   | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7<br>7 in T<br>20.<br>able 9                                 | 1 = Sum(74)m         .74       99.11         1.6       409.59         1.6       409.59         , Th1 (°C)         ug       Sep         76       0.94         Table 9c)       97         97       20.85         9, Th2 (°C)  |   | 38.53<br>399.86<br>Nov<br>1<br>20.24          | 26.61<br>408.01<br>Dec<br>1                         |       | (83)<br>(84)<br>(85)<br>(86)                                 |
| (83)m = 31.61 Total gains – i $(84)m = 424.55$ 7. Mean interverting Temperature Utilisation fac (86)m = 1 Mean internat (87)m = 20.01 Temperature (88)m = 20.16   | 57.41         internal and         447.55       4         rnal temper         e during hea         ctor for gain         Feb         1         al temperati         20.09         e during hea         20.16   | Additional control of the second seco | for each mon           121.46         147.2           (84)m = (73)r           472.99         475.0           (heating sease)           eriods in the I           iving area, h1           Apr         Ma           0.99         0.97           iving area T1         20.48         20.72           eriods in rest         20.18         20.18  | 9         1           n + (         1           1         4           con)         (ving)           vving         (folloc           2         2           2         2           0f dw         3   | 50.92       143.56         83)m       , watts         56.17       434.65         area from Tal         ee Table 9a)         Jun       Jul         0.88       0.72         ow steps 3 to         20.91       20.98         velling from Tal         20.19       20.19   | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7<br>7 in T<br>20.<br>able 9                                 | 1 = Sum(74)m         .74       99.11         1.6       409.59         1.6       409.59         , Th1 (°C)         ug       Sep         76       0.94         Table 9c)       97         97       20.85         9, Th2 (°C)  |   | 38.53<br>399.86<br>Nov<br>1<br>20.24          | 26.61<br>408.01<br>Dec<br>1<br>19.99                |       | (83)<br>(84)<br>(85)<br>(86)<br>(86)<br>(87)                 |
| (83)m = 31.61 Total gains – i $(84)m = 424.55$ 7. Mean intervertion factors Utilisation factors $(86)m = 1$ Mean intervertion $(87)m = 20.01$ Temperature $(88)m = 20.16$ Utilisation factors $(81)m = 20.16$ | 57.41<br>internal and<br>447.55<br>during hea<br>ctor for gain<br>Feb<br>1<br>al temperat<br>20.09<br>during hea<br>20.16  | culated<br>87.27<br>d solar<br>462.43<br>rature (<br>ating points for ling<br>Mar<br>1<br>20.25<br>ating points<br>20.17<br>ns for r   | for each mon           121         147.2           (84)m = (73)r           (84)m = (73)r           472.99         475.0           472.99         475.0           (heating sease           eriods in the l           tving area, h1           Apr         Ma           0.99         0.97           iving area T1         20.48           20.48         20.72           eriods in rest         20.18           20.18         20.11 | 9         1           n + (         1           1         4           on)         ving           ving,m (s         y           (follc         2           2         2           of dw         3           2         2   | 50.92       143.56         83)m       , watts         56.17       434.65         area from Tale       area         ee Table 9a)       Jun         Jun       Jul         0.88       0.72         ow steps 3 to       20.91         20.91       20.98         velling from Tale       20.19         ,m (see Table       (see Table)            | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7<br>7 in T<br>20.<br>able 9<br>20.<br>20.                   | I = Sum(74)m         .74       99.11         I.6       409.59         I.6       409.59         , Th1 (°C)         ug       Sep         76       0.94         Table 9c)         97       20.85         9, Th2 (°C)         19       20.18  | <br>6 <mark>5.88</mark><br>400.2<br>0.99<br>20.55<br>20.18                                  | 38.53<br>399.86<br>Nov<br>1<br>20.24<br>20.17 | 26.61<br>408.01<br>Dec<br>1<br>19.99<br>20.17       |       | (83)<br>(84)<br>(85)<br>(86)<br>(86)<br>(87)<br>(88)         |
| (83)m = 31.61 Total gains – i $(84)m = 424.55$ 7. Mean interverting Temperature Utilisation fac $(86)m = 1$ Mean internat $(87)m = 20.01$ Temperature $(88)m = 20.16$ Utilisation fac $(89)m = 1$             | 57.41         internal and         447.55       4         rnal temper         e during heat         ctor for gain         Feb         1         al temperation         20.09         e during heat         20.16         ctor for gain         1   | culated<br>87.27<br>d solar<br>462.43<br>rature (<br>ating pe<br>ns for li<br>Mar<br>1<br>20.25<br>ating pe<br>20.17<br>ns for r<br>1  | for each mon         121.46       147.2 $(84)m = (73)r$ $(72.99)$ 475.0         472.99       475.0         (heating sease         eriods in the l         tving area, h1         Apr       Ma         0.99       0.97         iving area T1       20.48       20.72         eriods in rest       20.18       20.14         est of dwelling       0.99       0.95   | 9         1           n + (         1           1         4           on)         ving           ving,m (s         y           (follc         2           2         2           of dw         3           3         2           g, h2         1   | 50.92       143.56         83)m       , watts         56.17       434.65         area from Tale       area         ee Table 9a)       Jun         Jun       Jul         0.88       0.72         ow steps 3 to       20.91         20.19       20.19         ,m (see Table       0.6  | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7<br>7 in T<br>20.<br>20.<br>20.<br>20.<br>20.<br>20.<br>20. | I = Sum(74)m         .74       99.11         I.6       409.59         I.7       20.9         I.8       0.9         I.9       20.18   | <br>6 <mark>5.88</mark><br>400.2<br>400.2<br>20.55<br>20.18<br>20.18                        | 38.53<br>399.86<br>Nov<br>1<br>20.24          | 26.61<br>408.01<br>Dec<br>1<br>19.99                |       | (83)<br>(84)<br>(85)<br>(86)<br>(86)<br>(87)                 |
| (83)m = 31.61 Total gains – i $(84)m = 424.55$ 7. Mean interverting Utilisation factor $(86)m = 1$ Mean internat $(87)m = 20.01$ Temperature $(88)m = 20.16$ Utilisation factor $(89)m = 1$ Mean internat     | 57.41         internal and         447.55       4         rnal temper         e during hea         ctor for gain         Feb         1         al temperati         20.09         e during hea         20.16         internal temperation         1         al temperation         20.16         1         al temperation         1         al temperation         1         1         1         1         1         1         1 | Advantage of the second | for each mon         121.46       147.2         (84)m = (73)r         472.99       475.0         (heating sease         eriods in the I         ving area, h1         Apr       Ma         0.99       0.97         iving area T1       20.48       20.72         eriods in rest       20.18       20.11         est of dwelling       0.99       0.95         he rest of dwelling       0.95                                     | 9         1           n + (         1           1         4           on)         (ving           vving         (folloc           2         2           (folloc         2           2         2           (folloc         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           4         1           4         1           4         1           4         1           2         2           2         2           2         2           3         2           4         1           4         1           4         1           4         1           4         1           4         1 <td>50.92       143.56         83)m       , watts         56.17       434.65         area from Tal         ee Table 9a)         Jun       Jul         0.88       0.72         ow steps 3 to         20.91       20.98         velling from Tal         20.19       20.19         ,m (see Table         0.82       0.6         172 (follow steps)</td> <td>(83)m<br/>123<br/>421<br/>ble 9<br/>A<br/>0.7<br/>7 in T<br/>20.<br/>able 9<br/>20.<br/>9a)<br/>0.6<br/>eps 3</td> <td>1 = Sum(74)m         .74       99.11         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       0.94         1.6       0.94         1.7       20.85         1.9       20.18         1.9       20.18         1.9       0.9         1.0       0.9         1.0       0.9</td> <td><br/>6<mark>5.88<br/>400.2<br/>400.2<br/>0.99<br/>20.55<br/>20.18<br/>0.99<br/>e 9c)</mark></td> <td>38.53<br/>399.86<br/>Nov<br/>1<br/>20.24<br/>20.17</td> <td>26.61<br/>408.01<br/>1<br/>19.99<br/>20.17</td> <td></td> <td>(83)<br/>(84)<br/>(85)<br/>(86)<br/>(87)<br/>(88)<br/>(88)<br/>(89)</td> | 50.92       143.56         83)m       , watts         56.17       434.65         area from Tal         ee Table 9a)         Jun       Jul         0.88       0.72         ow steps 3 to         20.91       20.98         velling from Tal         20.19       20.19         ,m (see Table         0.82       0.6         172 (follow steps) | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7<br>7 in T<br>20.<br>able 9<br>20.<br>9a)<br>0.6<br>eps 3   | 1 = Sum(74)m         .74       99.11         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       0.94         1.6       0.94         1.7       20.85         1.9       20.18         1.9       20.18         1.9       0.9         1.0       0.9         1.0       0.9 | <br>6 <mark>5.88<br/>400.2<br/>400.2<br/>0.99<br/>20.55<br/>20.18<br/>0.99<br/>e 9c)</mark> | 38.53<br>399.86<br>Nov<br>1<br>20.24<br>20.17 | 26.61<br>408.01<br>1<br>19.99<br>20.17              |       | (83)<br>(84)<br>(85)<br>(86)<br>(87)<br>(88)<br>(88)<br>(89) |
| (83)m = 31.61 Total gains – i $(84)m = 424.55$ 7. Mean interverting Temperature Utilisation fac $(86)m = 1$ Mean internat $(87)m = 20.01$ Temperature $(88)m = 20.16$ Utilisation fac $(89)m = 1$             | 57.41         internal and         447.55       4         rnal temper         e during hea         ctor for gain         Feb         1         al temperati         20.09         e during hea         20.16         internal temperation         1         al temperation         20.16         1         al temperation         1         al temperation         1         1         1         1         1         1         1 | culated<br>87.27<br>d solar<br>462.43<br>rature (<br>ating pe<br>ns for li<br>Mar<br>1<br>20.25<br>ating pe<br>20.17<br>ns for r<br>1  | for each mon         121.46       147.2 $(84)m = (73)r$ $(72.99)$ 475.0         472.99       475.0         (heating sease         eriods in the l         tving area, h1         Apr       Ma         0.99       0.97         iving area T1       20.48       20.72         eriods in rest       20.18       20.14         est of dwelling       0.99       0.95   | 9         1           n + (         1           1         4           on)         (ving           vving         (folloc           2         2           (folloc         2           2         2           (folloc         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           2         2           4         1           4         1           4         1           4         1           2         2           2         2           2         2           3         2           4         1           4         1           4         1           4         1           4         1           4         1 <td>50.92       143.56         83)m       , watts         56.17       434.65         area from Tale       area         ee Table 9a)       Jun         Jun       Jul         0.88       0.72         ow steps 3 to       20.91         20.19       20.19         ,m (see Table       0.6</td> <td>(83)m<br/>123<br/>421<br/>ble 9<br/>A<br/>0.7<br/>7 in T<br/>20.<br/>20.<br/>20.<br/>20.<br/>20.<br/>20.<br/>20.</td> <td>r = Sum(74)m         .74       99.11         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         0, Th1 (°C)         10       Sep         76       0.94         76       0.94         76       0.94         70       20.85         97       20.85         97       20.18         35       0.9         9       to 7 in Table         17       20.04</td> <td><br/>(82)m<br/>65.88<br/>400.2<br/>400.2<br/>20.55<br/>20.55<br/>20.18<br/>0.99<br/>e 9c)<br/>19.62</td> <td>38.53<br/>399.86<br/>Nov<br/>1<br/>20.24<br/>20.17</td> <td>26.61<br/>408.01<br/>1<br/>19.99<br/>20.17<br/>1<br/>18.8</td> <td></td> <td>(83)<br/>(84)<br/>(85)<br/>(86)<br/>(86)<br/>(87)<br/>(88)</td>  | 50.92       143.56         83)m       , watts         56.17       434.65         area from Tale       area         ee Table 9a)       Jun         Jun       Jul         0.88       0.72         ow steps 3 to       20.91         20.19       20.19         ,m (see Table       0.6  | (83)m<br>123<br>421<br>ble 9<br>A<br>0.7<br>7 in T<br>20.<br>20.<br>20.<br>20.<br>20.<br>20.<br>20. | r = Sum(74)m         .74       99.11         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         1.6       409.59         0, Th1 (°C)         10       Sep         76       0.94         76       0.94         76       0.94         70       20.85         97       20.85         97       20.18         35       0.9         9       to 7 in Table         17       20.04  | <br>(82)m<br>65.88<br>400.2<br>400.2<br>20.55<br>20.55<br>20.18<br>0.99<br>e 9c)<br>19.62   | 38.53<br>399.86<br>Nov<br>1<br>20.24<br>20.17 | 26.61<br>408.01<br>1<br>19.99<br>20.17<br>1<br>18.8 |       | (83)<br>(84)<br>(85)<br>(86)<br>(86)<br>(87)<br>(88)         |

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$ 

| (92)m=         | 19.18     | 19.29                   | 19.5                          | 19.81                | 20.12    | 20.36      | 20.42     | 20.42      | 20.28       | 19.9       | 19.49                   | 19.16      |         | (92)    |
|----------------|-----------|-------------------------|-------------------------------|----------------------|----------|------------|-----------|------------|-------------|------------|-------------------------|------------|---------|---------|
| Apply          | adjustr   | nent to t               | he mear                       | n internal           | temper   | ature fro  | m Table   | 4e, whe    | ere appro   | opriate    |                         | •          |         |         |
| (93)m=         | 19.03     | 19.14                   | 19.35                         | 19.66                | 19.97    | 20.21      | 20.27     | 20.27      | 20.13       | 19.75      | 19.34                   | 19.01      |         | (93)    |
| 8. Sp          | ace hea   | ting requ               | uirement                      | t                    |          |            |           |            |             |            |                         |            |         |         |
|                |           |                         |                               | mperatui<br>using Ta |          | ned at ste | ep 11 of  | Table 9    | b, so tha   | t Ti,m=(   | 76)m an                 | d re-calc  | ulate   |         |
|                | Jan       | Feb                     | Mar                           | Apr                  | May      | Jun        | Jul       | Aug        | Sep         | Oct        | Nov                     | Dec        |         |         |
| Utilisa        |           |                         | ains, hm                      | · ·                  | may      | oun        | 001       | ,          | 000         |            |                         | 200        |         |         |
| (94)m=         | 1         | 1                       | 0.99                          | 0.99                 | 0.95     | 0.82       | 0.62      | 0.66       | 0.9         | 0.99       | 1                       | 1          |         | (94)    |
| Usefu          | ul gains, | hmGm                    | , W = (94                     | 4)m x (84            | 4)m      |            |           |            |             |            |                         |            |         |         |
| (95)m=         | 423.88    | 446.42                  | 460                           | 465.92               | 450.56   | 374.52     | 267.43    | 278.3      | 368.55      | 394.34     | 398.6                   | 407.51     |         | (95)    |
| Mont           | nly aver  | age exte                | ernal tem                     | perature             | from Ta  | able 8     |           |            |             |            |                         | _          |         |         |
| (96)m=         | 4.3       | 4.9                     | 6.5                           | 8.9                  | 11.7     | 14.6       | 16.6      | 16.4       | 14.1        | 10.6       | 7.1                     | 4.2        |         | (96)    |
| Heat           | loss rate | e for mea               | an intern                     | al tempe             | erature, | Lm , W =   | =[(39)m : | x [(93)m   | – (96)m     | ]          |                         |            |         |         |
| (97)m=         |           | 1089.04                 | 980.78                        | 812.02               | 622.62   | 417.09     | 273.13    | 287.01     | 450.94      | 688.99     | 925.86                  | 1125.05    |         | (97)    |
|                | r         | ř – –                   | r                             | r each n             |          |            | h = 0.02  | 24 x [(97] | í Ì         | <u> </u>   | r –                     |            |         |         |
| (98)m=         | 524.66    | 431.84                  | 387.46                        | 249.2                | 128.01   | 0          | 0         | 0          | 0           | 219.22     | 379.63                  | 533.85     |         | -       |
|                |           |                         |                               |                      |          |            |           | Tota       | l per year  | (kWh/yea   | r) = Sum(9              | 8)15,912 = | 2853.88 | (98)    |
| Spac           | e heatin  | g require               | ement in                      | kWh/m <sup>2</sup>   | /year    |            |           |            |             |            |                         |            | 33.69   | (99)    |
| 9a. En         | ergy rec  | uiremer                 | nts – Ind                     | ividual h            | eating s | ystems i   | ncluding  | micro-C    | CHP)        |            |                         |            |         |         |
| Spac           | e heatir  | ng:                     |                               |                      |          |            |           |            |             |            |                         |            |         |         |
| Fract          | ion of sp | bace h <mark>ea</mark>  | at from s                     | econdar              | y/supple | mentary    | system    |            |             |            |                         |            | 0       | (201)   |
| Fract          | ion of sp | bace h <mark>e</mark> a | at from n                     | nain syst            | em(s)    |            |           | (202) = 1  | - (201) =   |            |                         |            | 1       | (202)   |
| Fract          | ion of to | tal heati               | ng from                       | main sys             | stem 1   |            |           | (204) = (2 | 02) × [1 –  | (203)] =   |                         |            | 1       | (204)   |
| Efficie        | ency of I | main spa                | ace heat                      | ing syste            | em 1     |            |           |            |             |            |                         |            | 89.9    | (206)   |
| Efficie        | ency of   | seconda                 | ry/suppl                      | ementar              | y heatin | g system   | n, %      |            |             |            |                         |            | 0       | (208)   |
|                | Jan       | Feb                     | Mar                           | Apr                  | May      | Jun        | Jul       | Aug        | Sep         | Oct        | Nov                     | Dec        | kWh/yea | _<br>ar |
| Spac           | e heatin  | g require               | ement (c                      | alculate             | d above  | )          |           |            |             |            |                         |            |         |         |
|                | 524.66    | 431.84                  | 387.46                        | 249.2                | 128.01   | 0          | 0         | 0          | 0           | 219.22     | 379.63                  | 533.85     |         |         |
| (211)m         | n = {[(98 | )m x (20                | 04)] } x 1                    | 00 ÷ (20             | )6)      |            |           |            |             |            |                         |            |         | (211)   |
|                | 583.6     | 480.36                  | 430.99                        | 277.19               | 142.4    | 0          | 0         | 0          | 0           | 243.85     | 422.28                  | 593.83     |         |         |
|                |           |                         |                               |                      |          |            |           | Tota       | l (kWh/yea  | ar) =Sum(2 | 211) <sub>15,1012</sub> | =          | 3174.51 | (211)   |
| Spac           | e heatin  | g fuel (s               | econdar                       | y), kWh/             | month    |            |           |            |             |            |                         |            |         | -       |
| = {[(98        | )m x (20  | 01)] } x 1              | 00 ÷ (20                      | 8)                   |          |            |           |            |             |            |                         |            |         |         |
| (215)m=        | 0         | 0                       | 0                             | 0                    | 0        | 0          | 0         | 0          | 0           | 0          | 0                       | 0          |         | _       |
|                |           |                         |                               |                      |          |            |           | Tota       | II (kWh/yea | ar) =Sum(2 | 215) <sub>15,1012</sub> | 2=         | 0       | (215)   |
|                | heating   | -                       |                               |                      |          |            |           |            |             |            |                         |            |         |         |
| Output         |           |                         |                               | ulated al            |          | 444.00     | 404.00    | 440.74     | 440.05      | 407.07     | 4 40 47                 | 404.4      |         |         |
| <b>F</b> #isis | 166.28    | 145.76                  | 151.19                        | 132.92               | 128.36   | 111.98     | 104.96    | 118.74     | 119.65      | 137.97     | 149.17                  | 161.4      |         |         |
|                |           | ater hea                |                               | 88.76                | 00.07    | 007        | 007       | 007        | 007         | 00.04      | 00.07                   | 00.44      | 86.7    | (216)   |
| (217)m=        | 89.11     | 89.07                   | 88.98                         | I 88./6              | 88.27    | 86.7       | 86.7      | 86.7       | 86.7        | 88.64      | 88.97                   | 89.14      |         | (217)   |
| Luci fo        |           | <sup>.</sup>            | 1.1.0.11.1                    |                      |          |            |           |            |             |            |                         |            |         |         |
|                |           | •                       | kWh/mo<br>) – (217)           | onth                 |          |            |           |            |             |            |                         |            |         |         |
|                | (64) = ו  | •                       | kWh/mo<br>) ÷ (217)<br>169.92 | onth                 | 145.42   | 129.16     | 121.07    | 136.96     | 138.01      | 155.65     | 167.66                  | 181.07     |         |         |

| Annual totals                                       |                           | kWh/yea                           | r _    | kWh/year                       | _      |
|---|---------------------------|-----------------------------------|--------|--------------------------------|--------|
| Space heating fuel used, main system 1              |                           |                                   |        | 3174.51                        |        |
| Water heating fuel used                             |                           |                                   | [      | 1844.9                         | ]      |
| Electricity for pumps, fans and electric keep-hot   |                           |                                   | _      |                                | _      |
| mechanical ventilation - balanced, extract or posit | ive input from out        | side                              | 191.68 |                                | (230a) |
| central heating pump:                               |                           |                                   | 30     |                                | (230c) |
| boiler with a fan-assisted flue                     |                           |                                   | 45     |                                | (230e) |
| Total electricity for the above, kWh/year           | :                         | sum of (230a)(230g) =             | [      | 266.68                         | (231)  |
| Electricity for lighting                            |                           |                                   | [      | 472.85                         | (232)  |
| 12a. CO2 emissions – Individual heating systems     | including micro-C         | HP                                |        |                                |        |
|   | <b>Energy</b><br>kWh/year | <b>Emission fac</b><br>kg CO2/kWh | tor    | <b>Emissions</b><br>kg CO2/yea | r      |
| Space heating (main system 1)                       | (211) x                   | 0.216                             | = [    | 685.69                         | (261)  |
| Space heating (secondary)                           | (215) x                   | 0.519                             | = [    | 0                              | (263)  |
| Water heating                                       | (219) x                   | 0.216                             | =      | 398.5                          | (264)  |

(261) + (262) + (263) + (264) =

0.519

0.519

sum of (265)...(271) =

 $(272) \div (4) =$ 

=

(231) x

(232) x

Space and water heating

Dwelling CO2 Emission Rate

Electricity for lighting

Total CO2, kg/year

El rating (section 14)

Electricity for pumps, fans and electric keep-hot

1084.19

138.41

2<mark>45.41</mark>

1468.01

17.33

85

(265)

(267)

(268)

(272)

(273)

(274)

|   |  |                     | User De  | etails:                     |              |               |                       |           |                                       |              |
|---|--|---------------------|----------|-----------------------------|--------------|---------------|-----------------------|-----------|---------------------------------------|--------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 201  |                     | ;        | Stroma<br>Softwa            | re Ver       |               |                       | Versio    | n: 1.0.4.23                           |              |
| Addross I   | 1 Bed Flat, 219-223  |                     |          | Address:                    |              | nh lunct      | ion I ON              |           |                                       |              |
| Address :<br>1. Overall dwelling dimer  |  | Columand            |          | ie, Loug                    | προιοαί      | JII JUIICI    | ION, LON              |           |                                       |              |
| Ground floor  |  |                     | Area     | · ,                         | (1a) x       | <b>Av. He</b> | <b>ight(m)</b><br>2.5 | (2a) =    | <b>Volume(m<sup>3</sup>)</b><br>124.5 | )<br>(3a)    |
| Total floor area TFA = (1a  | i)+(1b)+(1c)+(1d)+(1e  | e)+(1n)             | 4        | 9.8                         | (4)          |               |                       |           |                                       |              |
| Dwelling volume   |  |                     |          |                             | (3a)+(3b)    | +(3c)+(3d     | l)+(3e)+              | .(3n) =   | 124.5                                 | (5)          |
| 2. Ventilation rate:  |  |                     |          |                             |              |               |                       |           |                                       |              |
| Number of chimneys  | heating h  | econdary<br>leating | (<br>  + | other                       | 1 = [        | total         | x 4                   | 40 =      | m <sup>3</sup> per hour               | (6a)         |
| Number of open flues  | 0 +  | 0                   | +        | 0                           | ] [<br>] = [ | 0             |                       | 20 =      | 0                                     | (6b)         |
| Number of intermittent far  | וב ביום אוניים ביום אוניים ביום אוניים ביום אוניים ביום ביום אוניים ביום אוניים ביום אוניים ביום אוניים ביום א<br>ואני גער ביום אוניים ביום אוניים ביום אוניים ביום אוניים ביום אוניים ביום אוניים ביום אוניים ביום אוניים ביום או |                     |          |                             |              | 0             | x 1                   | 10 =      | 0                                     | (7a)         |
| Number of passive vents   |  |                     |          |                             |              | 0             | x 1                   | 10 =      | 0                                     | (7b)         |
| Number of flueless gas fir  | es   |                     |          |                             |              | 0             | x 4                   | 40 =      | 0                                     | (7c)         |
|   |  |                     |          |                             |              |               |                       | Air ch    | ange <mark>s per</mark> ho            | ur           |
| Infiltration due to chimney   |  |                     |          |                             |              | 0             |                       | ÷ (5) =   | 0                                     | (8)          |
| Number of storeys in th<br>Additional infiltration  | e dwelling (ns)  |                     |          |                             |              |               |                       | •1]x0.1 = | 0                                     | (9)<br>(10)  |
| Structural infiltration: 0.2<br>if both types of wall are pre<br>deducting areas of opening | esent, use the value corres  |                     |          |                             | •            | UCTION        |                       |           | 0                                     | (11)         |
| If suspended wooden fl  |  | ed) or 0.1          | (seale   | d), else                    | enter 0      |               |                       |           | 0                                     | (12)         |
| If no draught lobby, ente   |  |                     |          |                             |              |               |                       |           | 0                                     | (13)         |
| Percentage of windows   | and doors draught st   | ripped              |          |                             | v (1.4) · 1  | 001 -         |                       | ·         | 0                                     | (14)         |
| Window infiltration   |  |                     |          | 0.25 - [0.2<br>(8) + (10) - |              |               | ⊾ (15) –              |           | 0                                     | (15)         |
| Air permeability value, o   | n50 expressed in cub   | nic metres          |          |                             |              |               |                       | area      | 0                                     | (16)<br>(17) |
| If based on air permeabilit   |  |                     | •        | •                           | •            |               | invelope              | uluu      | 2<br>0.1                              | (18)         |
| Air permeability value applies  | •  |                     |          |                             |              | is being us   | sed                   | I         | 0.1                                   |              |
| Number of sides sheltered   | t  |                     |          |                             |              |               |                       |           | 3                                     | (19)         |
| Shelter factor  |  |                     |          | (20) = 1 - [                |              | 9)] =         |                       |           | 0.78                                  | (20)         |
| Infiltration rate incorporati   | -  |                     | (        | (21) = (18)                 | x (20) =     |               |                       |           | 0.08                                  | (21)         |
| Infiltration rate modified for  |  | i i                 | <u> </u> |                             | -            | •             |                       |           |                                       |              |
|   | Mar Apr May  | Jun                 | Jul      | Aug                         | Sep          | Oct           | Nov                   | Dec       |                                       |              |
| Monthly average wind spe  | - I I I  |                     | <u> </u> | <u> </u>                    | ,            | 4.0           | 4.5                   | 47        |                                       |              |
| (22)m= 5.1 5  | 4.9 4.4 4.3  | 3.8                 | 3.8      | 3.7                         | 4            | 4.3           | 4.5                   | 4.7       |                                       |              |
| Wind Factor (22a)m = (22  | ,<br>  |                     | ,        |                             |              |               | <b>I</b>              |           |                                       |              |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08   | 0.95                | 0.95     | 0.92                        | 1            | 1.08          | 1.12                  | 1.18      |                                       |              |

| Adjuste                          | ed infiltra           | ation rat  | e (allowi  | ng for sh               | elter an    | d wind s    | peed) =    | (21a) x      | (22a)m      |                       | _                |           |                  |                |
|----------------------------------|-----------------------|------------|------------|-------------------------|-------------|-------------|------------|--------------|-------------|-----------------------|------------------|-----------|------------------|----------------|
|                                  | 0.1                   | 0.1        | 0.09       | 0.09                    | 0.08        | 0.07        | 0.07       | 0.07         | 0.08        | 0.08                  | 0.09             | 0.09      |                  |                |
|                                  | ate effec<br>echanica |            | -          | rate for t              | he appli    | cable ca    | se         |              |             |                       |                  |           | 0.5              | (220)          |
|                                  |                       |            |            | endix N, (2             | 3b) = (23a  | a) x Fmv (e | equation ( | N5)) . other | wise (23b   | ) = (23a)             |                  |           | 0.5              | (23a)<br>(23b) |
|                                  |                       |            |            | iency in %              |             |             |            |              |             | ) (200)               |                  |           | 0.5              |                |
|                                  |                       |            | -          | -                       | -           |             |            |              |             | 2b)m i (              | 22h) v [         | 1 – (23c) | 73.1             | (23c)          |
| (24a)m=                          |                       | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21 (24a    | 0.21        | 0.22                  | 230) × [<br>0.22 | 0.23      | - 100j           | (24a)          |
|                                  |                       |            |            |                         |             |             |            |              |             |                       |                  | 0.20      | l                | (,)            |
| D) II<br>(24b)m=                 |                       |            |            | entilation              |             |             |            | 0 (240       | 0 m = (22)  | $\frac{2}{0}$ m + (1) | 230)             | 0         | 1                | (24b)          |
|                                  |                       | -          |            | •                       | -           | -           | -          | -            | Ţ           | 0                     | 0                | 0         |                  | (240)          |
| ,                                |                       |            |            | ntilation c<br>hen (24c | •           | •           |            |              |             | .5 × (23t             | <b>)</b> )       |           |                  |                |
| (24c)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0                     | 0                | 0         |                  | (24c)          |
|                                  |                       |            |            | ole hous                |             |             |            |              |             |                       |                  |           | 1                |                |
| i                                | if (22b)m             | n = 1, the | en (24d)   | m = (22k                | o)m othe    | erwise (2   | 4d)m =     | 0.5 + [(2    | 2b)m² x     | 0.5]                  |                  |           | 1                |                |
| (24d)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0                     | 0                | 0         |                  | (24d)          |
| Effe                             | ctive air             | change     | rate - er  | nter (24a               | ) or (24b   | o) or (24   | c) or (24  | d) in box    | (25)        |                       |                  |           |                  |                |
| (25)m=                           | 0.23                  | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21         | 0.21        | 0.22                  | 0.22             | 0.23      |                  | (25)           |
| 3. He                            | at losses             | s and he   | eat loss i | oaramete                | er:         |             |            |              |             |                       |                  |           |                  | _              |
| ELEN                             |                       | Gros       |            | Openin                  |             | Net Ar      | ea         | U-valu       | Je          | AXU                   |                  | k-value   | e                | AXk            |
|                                  |                       | area       |            | 'n                      |             | A ,n        | n²         | W/m2         | K           | (VV/                  | K)               | kJ/m²·l   | ĸ                | kJ/K           |
| Windo                            | ws Type               | 1          |            |                         |             | 10.8        | x1/        | [1/( 0.73 )+ | - 0.04] =   | 7.66                  |                  |           |                  | (27)           |
| Windo                            | <mark>ws</mark> Type  | 2          |            |                         |             | 2.475       | ; x1/      | [1/( 0.73 )+ | - 0.04] =   | 1.76                  |                  |           |                  | (27)           |
| Wall <mark>s</mark> <sup>-</sup> | Type1                 | 19.        | 5          | 10.8                    |             | 8.7         | x          | 0.15         | ] = [       | 1.31                  |                  |           |                  | (29)           |
| Walls <sup>-</sup>               | Гуре2                 | 3.5        |            | 2.47                    |             | 1.03        | ×          | 0.15         | <br>  =     | 0.15                  | F i              |           | <b>i i</b>       | (29)           |
| Total a                          | rea of el             | lements    | , m²       |                         |             | 23          |            |              |             |                       |                  |           |                  | (31)           |
| Party v                          | vall                  |            |            |                         |             | 51.75       | j x        | 0            |             | 0                     |                  |           |                  | (32)           |
| Party f                          | _                     |            |            |                         |             | 49.8        | $\exists$  |              | เ           |                       | L                |           | $\dashv$         | (32a)          |
| Party c                          | eiling                |            |            |                         |             | 49.8        |            |              |             |                       | ĺ                |           | $\exists$        | (32b)          |
| Interna                          | al wall **            |            |            |                         |             | 45.6        |            |              |             |                       | [                |           | $\exists \vdash$ | (32c)          |
|                                  |                       |            |            |                         |             |             | ated using | ı formula 1, | /[(1/U-valu | ıe)+0.04] a           | as given in      | paragraph | 3.2              |                |
|                                  | heat los              |            |            | nternal wall            | s and pan   | litions     |            | (26)(30)     | + (32) =    |                       |                  |           | 40.07            | (22)           |
|                                  | apacity (             |            |            | 0)                      |             |             |            | (20)(00)     |             | (30) + (32            | 2) + (225)       | (220) -   | 10.87            |                |
|                                  |                       |            | . ,        | - Cm ·                  |             | k l/m2k     |            |              |             | tive Value            | · · · ·          | (326) =   | 13269.5          |                |
|                                  |                       | -          |            | P = Cm ÷                | ,           |             |            | racisaly the |             |                       |                  | abla 1f   | 250              | (35)           |
|                                  | used instea           |            |            |                         | constructi  | ion ale not | KIIOWII PI | ecisely life | inucative   | values of             |                  |           |                  |                |
| Therm                            | al bridge             | es : S (L  | x Y) cal   | culated u               | using Ap    | pendix ł    | <          |              |             |                       |                  |           | 5.22             | (36)           |
|                                  |                       |            | are not kn | own (36) =              | = 0.05 x (3 | 1)          |            |              |             |                       |                  |           |                  |                |
| Total fa                         | abric hea             | at loss    |            |                         |             |             |            |              | (33) +      | (36) =                |                  |           | 16.09            | (37)           |
| Ventila                          | tion hea              | t loss ca  | alculated  | monthly                 | /           |             |            |              | (38)m       | = 0.33 × (            | 25)m x (5        | )         | 1                |                |
|                                  | Jan                   | Feb        | Mar        | Apr                     | May         | Jun         | Jul        | Aug          | Sep         | Oct                   | Nov              | Dec       |                  |                |
| (38)m=                           | 9.59                  | 9.51       | 9.43       | 9.03                    | 8.95        | 8.55        | 8.55       | 8.47         | 8.71        | 8.95                  | 9.11             | 9.27      |                  | (38)           |
| Heat tr                          | ansfer c              | oefficier  | nt, W/K    |                         |             |             |            |              | (39)m       | = (37) + (            | 38)m             |           |                  |                |
| (39)m=                           | 25.68                 | 25.6       | 25.52      | 25.12                   | 25.04       | 24.64       | 24.64      | 24.56        | 24.8        | 25.04                 | 25.2             | 25.36     |                  |                |
| Stroma I                         | FSAP 2012             | 2 Version: | 1.0.4.23   | (SAP 9.92)              | - http://ww | ww.stroma   | .com       |              | 1           | Average =             | Sum(39)1         | 12 /12=   | 25.1p            | age 2 of 39)   |

| Heat lo                | ss para               | ımeter (H                       | HLP), W     | /m²K                 |                |            |             |                        | (40)m                     | = (39)m ÷                  | - (4)                  |          |         |      |
|------------------------|-----------------------|---------------------------------|-------------|----------------------|----------------|------------|-------------|------------------------|---------------------------|----------------------------|------------------------|----------|---------|------|
| (40)m=                 | 0.52                  | 0.51                            | 0.51        | 0.5                  | 0.5            | 0.49       | 0.49        | 0.49                   | 0.5                       | 0.5                        | 0.51                   | 0.51     |         |      |
|                        |                       |                                 |             |                      |                | !          |             | 1                      | ,                         | Average =                  | Sum(40)1.              | .12 /12= | 0.5     | (40) |
| Numbe                  | -                     | /s in mo                        | <u> </u>    | r í                  |                | <u> </u>   | I           | <u> </u>               |                           |                            |                        | _        |         |      |
|                        | Jan                   | Feb                             | Mar         | Apr                  | May            | Jun        | Jul         | Aug                    | Sep                       | Oct                        | Nov                    | Dec      |         |      |
| (41)m=                 | 31                    | 28                              | 31          | 30                   | 31             | 30         | 31          | 31                     | 30                        | 31                         | 30                     | 31       |         | (41) |
|                        |                       |                                 |             |                      |                |            |             |                        |                           |                            |                        |          |         |      |
| 4. Wa                  | ter heat              | ting ene                        | rgy requ    | irement:             |                |            |             |                        |                           |                            |                        | kWh/ye   | ear:    |      |
| if TF.                 | A > 13.9              | upancy,<br>9, N = 1<br>9, N = 1 |             | (1 - exp             | (-0.0003       | 349 x (TF  | FA -13.9    | )2)] + 0.(             | 0013 x ( <sup>-</sup>     | TFA -13                    |                        | 68       |         | (42) |
| Reduce                 | the annua             | al average                      | hot water   | usage by             | 5% if the c    |            | designed    | (25 x N)<br>to achieve |                           | se target o                |                        | 1.2      |         | (43) |
|                        | Jan                   | Feb                             | Mar         | Apr                  | May            | Jun        | Jul         | Aug                    | Sep                       | Oct                        | Nov                    | Dec      |         |      |
| Hot wate               | r usage i             | n litres per                    | r day for e |                      | ,              | ctor from  | Table 1c x  | -                      |                           |                            |                        |          |         |      |
| (44)m=                 | 81.62                 | 78.65                           | 75.68       | 72.72                | 69.75          | 66.78      | 66.78       | 69.75                  | 72.72                     | 75.68                      | 78.65                  | 81.62    |         |      |
|                        |                       |                                 |             | I                    |                | I          |             | Į                      | -                         | l<br>Total = Su            | m(44) <sub>112</sub> = |          | 890.4   | (44) |
| Ener <mark>gy</mark> c | content of            | hot water                       | used - ca   | lculated m           | onthly $= 4$ . | 190 x Vd,r | m x nm x L  | OTm / 3600             | ) kWh/mor                 | oth ( <mark>see T</mark> a | ables 1b, 1            | c, 1d)   |         |      |
| (45)m=                 | 1 <mark>2</mark> 1.04 | 105.86                          | 109.24      | 95. <mark>2</mark> 4 | 91.38          | 78.86      | 73.07       | 83.85                  | 84.85                     | 98.89                      | 107.94                 | 117.22   |         |      |
| If instant             | aneous w              | vətor hoati                     | ng at poin  | t of use (no         | hot water      | r storage) | enter () in | boxes (46              |                           | Total = Su                 | m(45) <sub>112</sub> = | :        | 1167.46 | (45) |
|                        |                       |                                 |             |                      |                |            |             |                        |                           |                            |                        |          |         | (10) |
| (46)m=<br>Water s      | 18.16                 | 15.88                           | 16.39       | 14.29                | 13.71          | 11.83      | 10.96       | 12.58                  | 12.73                     | 14.83                      | 16.19                  | 17.58    |         | (46) |
|                        | -                     |                                 | includir    | ng any se            | olar or M      | WHRS       | storage     | within sa              | ame ves                   | sel                        |                        | )        |         | (47) |
|                        |                       |                                 |             | -                    |                | enter 110  |             |                        |                           |                            | · · · · ·              | 5        |         | ()   |
|                        | •                     | -                               |             |                      | -              |            |             | ombi boil              | ers) ente                 | er '0' in (                | 47)                    |          |         |      |
| Water s                | storage               | loss:                           |             | ,                    |                |            |             |                        |                           | ·                          | ,                      |          |         |      |
| a) If m                | anufact               | urer's d                        | eclared I   | oss facto            | or is kno      | wn (kWł    | n/day):     |                        |                           |                            | (                      | 0        |         | (48) |
| Tempe                  | rature f              | actor fro                       | m Table     | 2b                   |                |            |             |                        |                           |                            | (                      | C        |         | (49) |
| Energy                 | lost fro              | m watei                         | · storage   | e, kWh/ye            | ear            |            |             | (48) x (49)            | ) =                       |                            | (                      | )        |         | (50) |
|                        |                       |                                 |             | •                    |                | or is not  |             |                        |                           |                            |                        |          |         |      |
|                        |                       | -                               |             |                      | le 2 (kW       | h/litre/da | ay)         |                        |                           |                            | (                      | 0        |         | (51) |
|                        | -                     | eating s<br>from Ta             |             | 011 4.3              |                |            |             |                        |                           |                            |                        | 2        | l       | (52) |
|                        |                       | actor fro                       |             | 2b                   |                |            |             |                        |                           |                            |                        | )<br>)   |         | (52) |
|                        |                       |                                 |             | e, kWh/ye            | aar            |            |             | (47) x (51)            | ) x (52) x ( <sup>4</sup> | 53) -                      |                        |          |         | (54) |
| •••                    |                       | (54) in (5                      | -           | , KVVII/y            | 501            |            |             | (47) X (01)            | )                         | 00) -                      |                        | )<br>)   |         | (54) |
|                        | . ,                   | . , .                           | ,           | for each             | month          |            |             | ((56)m = (             | 55) × (41)ı               | m                          | `                      | 5        |         | ()   |
| (56)m=                 | 0                     | 0                               | 0           | 0                    | 0              | 0          | 0           | 0                      | 0                         | 0                          | 0                      | 0        |         | (56) |
|                        | r contains            | s dedicate                      | d solar sto | prage, (57)          | -              |            |             | -                      | 7)m = (56)                | -                          | H11) is fro            | -        | ix H    |      |
| (57)m=                 | 0                     | 0                               | 0           | 0                    | 0              | 0          | 0           | 0                      | 0                         | 0                          | 0                      | 0        |         | (57) |
| Priman                 |                       | loss (ar                        | nual) fr    | ,<br>om Table        | <u>.</u> 3     | -          | •           | •                      | •                         |                            |                        | )        |         | (58) |
| -                      |                       |                                 |             |                      |                | (59)m = (  | (58) ÷ 36   | 65 × (41)              | m                         |                            | Ľ`                     | -        | I       |      |
| -                      |                       |                                 |             |                      |                | . ,        | . ,         | ng and a               |                           | r thermo                   | stat)                  |          |         |      |
| (59)m=                 | 0                     | 0                               | 0           | 0                    | 0              | 0          | 0           | 0                      | 0                         | 0                          | 0                      | 0        |         | (59) |
| L                      |                       |                                 |             |                      |                |            |             |                        |                           |                            |                        |          | I       |      |

| Combi   | loss ca               | alculated                | for eac   | h month     | (61)m =     | (60   | )) ÷ 36 | 65 × (41)                | )m           |              |                     |               |             |                      |      |
|---------|-----------------------|--------------------------|-----------|-------------|-------------|-------|---------|--------------------------|--------------|--------------|---------------------|---------------|-------------|----------------------|------|
| (61)m=  | 11.76                 | 10.62                    | 11.74     | 11.35       | 11.71       | 1     | 1.32    | 11.69                    | 11.7         | 11.33        | 11.73               | 11.37         | 11.76       | ]                    | (61) |
| Total h | neat rec              | uired for                | water h   | neating     | calculated  | d fo  | r eacl  | n month                  | (62)m =      | 0.85 ×       | (45)m ·             | + (46)m +     | (57)m +     | -<br>· (59)m + (61)m |      |
| (62)m=  | 132.8                 | 116.48                   | 120.98    | 106.58      | 103.1       | 9     | 0.18    | 84.76                    | 95.56        | 96.19        | 110.62              | 2 119.31      | 128.98      |                      | (62) |
| Solar D | -IW input             | calculated               | using Ap  | pendix G    | or Appendix | κΗ (  | (negati | ve quantity              | /) (enter '0 | ' if no sola | ar contrib          | ution to wate | er heating) |                      |      |
| (add a  | ddition               | al lines if              | FGHR      | S and/or    | WWHRS       | S ap  | plies   | , see Ap                 | pendix (     | G)           |                     |               |             | _                    |      |
| (63)m=  | 0                     | 0                        | 0         | 0           | 0           |       | 0       | 0                        | 0            | 0            | 0                   | 0             | 0           |                      | (63) |
| Outpu   | t from v              | vater hea                | ter       |             |             |       |         |                          | -            | -            |                     |               | _           | _                    |      |
| (64)m=  | 132.8                 | 116.48                   | 120.98    | 106.58      | 103.1       | 9     | 0.18    | 84.76                    | 95.56        | 96.19        | 110.62              | 2 119.31      | 128.98      |                      | _    |
|         |                       |                          |           |             |             |       |         |                          | Outp         | out from w   | ater hea            | ter (annual)  | 112         | 1305.54              | (64) |
| Heat g  | ains fro              | om water                 | heating   | g, kWh/r    | nonth 0.2   | 5 ′   | [0.85   | × (45)m                  | + (61)m      | n] + 0.8 x   | x [(46)r            | n + (57)m     | + (59)m     | []                   |      |
| (65)m=  | 43.19                 | 37.85                    | 39.26     | 34.5        | 33.31       | 2     | 9.05    | 27.22                    | 30.81        | 31.05        | 35.81               | 38.73         | 41.92       |                      | (65) |
| inclu   | ıde (57               | )m in calo               | culation  | of (65)r    | n only if c | cylir | nder i  | s in the c               | dwelling     | or hot w     | ater is             | from com      | munity h    | neating              |      |
| 5. In   | ternal g              | ains (see                | e Table   | 5 and 5     | a):         |       |         |                          |              |              |                     |               |             |                      |      |
| Metab   | olic gai              | ns (Table                | e 5), Wa  | atts        |             |       |         |                          |              |              |                     |               |             |                      |      |
|         | Jan                   | Feb                      | Mar       | Apr         | May         |       | Jun     | Jul                      | Aug          | Sep          | Oct                 | Nov           | Dec         |                      |      |
| (66)m=  | 84.21                 | 84.21                    | 84.21     | 84.21       | 84.21       | 8     | 84.21   | 84.21                    | 84.21        | 84.21        | 8 <mark>4.21</mark> | 84.21         | 84.21       |                      | (66) |
| Lightir | g gains               | s (calcula               | ted in A  | ppendix     | . L, equat  | tion  | L9 o    | r L9a), a                | lso see      | Table 5      |                     |               |             |                      |      |
| (67)m=  | 17.77                 | 15.79                    | 12.84     | 9.72        | 7.27        | (     | 5.13    | 6.63                     | 8.62         | 11.56        | 14.68               | 17.14         | 18.27       |                      | (67) |
| Applia  | nces ga               | ains (ca <mark>lc</mark> | ulated i  | n Appei     | ndix L, eq  | uat   | tion L  | 13 o <mark>r L1</mark> : | 3a), also    | see Ta       | ble 5               |               |             |                      |      |
| (68)m=  | 146.71                | 148.24                   | 144.4     | 136.23      | 125.92      | 1     | 16.23   | 109.76                   | 108.24       | 112.07       | 120.24              | 4 130.55      | 140.24      |                      | (68) |
| Cookir  | ng gain               | s (calcula               | ated in A | Appendi     | x L, equa   | tior  | n L15   | or L15a)                 | ), also se   | ee Table     | e 5                 |               |             |                      |      |
| (69)m=  | 31.42                 | 31.42                    | 31.42     | 31.42       | 31.42       | 3     | 1.42    | 31.42                    | 31.42        | 31.42        | 31.42               | 31.42         | 31.42       | 1                    | (69) |
| Pumps   | s and fa              | ans gains                | (Table    | 5a)         |             |       |         |                          |              |              |                     |               |             |                      |      |
| (70)m=  | 3                     | 3                        | 3         | 3           | 3           |       | 3       | 3                        | 3            | 3            | 3                   | 3             | 3           | ]                    | (70) |
| Losse   | s e.g. e              | vaporatio                | n (nega   | ative val   | ues) (Tab   | ble   | 5)      |                          |              | •            | •                   | •             |             |                      |      |
| (71)m=  | -67.37                | -67.37                   | -67.37    | -67.37      | -67.37      | -6    | 67.37   | -67.37                   | -67.37       | -67.37       | -67.37              | -67.37        | -67.37      | ]                    | (71) |
| Water   | heating               | ,<br>g gains (1          | Table 5)  |             | •           |       |         |                          |              |              | •                   | •             | <u>.</u>    |                      |      |
| (72)m=  | 58.05                 | 56.33                    | 52.77     | 47.92       | 44.78       | 4     | 0.35    | 36.58                    | 41.41        | 43.12        | 48.14               | 53.8          | 56.34       | ]                    | (72) |
| Total   | interna               | l gains =                | :         |             | -           |       | (66)    | m + (67)m                | n + (68)m -  | + (69)m +    | (70)m +             | (71)m + (72)  | )m          | 1                    |      |
| (73)m=  | 273.8                 | 271.62                   | 261.27    | 245.14      | 229.23      | 2     | 13.98   | 204.24                   | 209.52       | 218.02       | 234.3               | 2 252.75      | 266.11      | ]                    | (73) |
| 6. So   | lar gair              | is:                      | <u>.</u>  |             |             |       |         |                          |              |              |                     | •             | <u>.</u>    |                      |      |
| Solar ( | gains are             | calculated               | using sol | ar flux fro | n Table 6a  | and   | associ  | ated equa                | tions to co  | onvert to th | ne applic           | able orienta  | tion.       |                      |      |
| Orient  |                       | Access F                 |           | Are         |             |       | Flu     |                          | _            | g_           |                     | FF            |             | Gains                |      |
|         |                       | Table 6d                 |           | m²          |             |       | Tat     | ole 6a                   | Τ            | able 6b      |                     | Table 6c      |             | (W)                  |      |
| Southe  | ast <mark>0.9x</mark> | 0.77                     | )         | ( 2         | .47         | x     | 3       | 6.79                     | x            | 0.63         | x                   | 0.1           | =           | 3.98                 | (77) |
|         | ast <mark>0.9x</mark> | 0.77                     | )         | < _ 2       | .47         | x     | 6       | 2.67                     | x            | 0.63         | x                   | 0.1           | =           | 6.77                 | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77                     | )         | < 2         | .47         | x     | 8       | 5.75                     | x            | 0.63         | x                   | 0.1           | =           | 9.27                 | (77) |
|         | ast <mark>0.9x</mark> | 0.77                     | )         | ( 2         | .47         | x     | 1       | 06.25                    | x            | 0.63         | x                   | 0.1           | =           | 11.48                | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77                     | )         | ( 2         | .47         | x     | 1       | 19.01                    | x            | 0.63         | x                   | 0.1           | =           | 12.86                | (77) |

| Southeast 0  | .9x 0.77  | x  | 2.47  | 3  | ۲ 1   | 18.15  | x                          | 0.63   | x                      | 0.1    | =             | = 12.77  | (77)         |
|--|---|--|---|--|---|--|----------------------------|--|------------------------|--------|---------------|----------|--------------|
| Southeast 0  | . <mark>9x</mark> 0.77  | x  | 2.47  | ;  | ( 1   | 13.91  | x                          | 0.63   | ×                      | 0.1    | -             | = 12.31  | (77)         |
| Southeast 0  | .9x 0.77  | x  | 2.47  | ;  | ۲ (   | 04.39  | x                          | 0.63   | x                      | 0.1    | -             | = 11.28  | (77)         |
| Southeast 0  | .9x 0.77  | x  | 2.47  | ;  | <u>د</u> ا                                    | 92.85  | x                          | 0.63   | x                      | 0.1    | -             | = 10.03  | (77)         |
| Southeast 0  | .9x 0.77  | x  | 2.47  | 3  | (   | 69.27  | x                          | 0.63   | x                      | 0.1    | =             | = 7.48   | (77)         |
| Southeast 0  | .9x 0.77  | x  | 2.47  | 3  | ( ,   | 44.07  | x                          | 0.63   | ×                      | 0.1    |               | = 4.76   | (77)         |
| Southeast 0  | .9x 0.77  | x  | 2.47  | 3  | ( ;   | 31.49  | x                          | 0.63   | ×                      | 0.1    |               | = 3.4    | (77)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | ( ;   | 36.79  | 1                          | 0.63   | _ × [                  | 0.1    | -             | = 17.35  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | ( (   | 62.67  | 1                          | 0.63   | _ × [                  | 0.1    | <b>-</b>      | = 29.55  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  |  | ( ;   | 85.75  | 1                          | 0.63   |                        | 0.1    | <u> </u>      | = 40.43  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | · [ 1   | 06.25  | 1                          | 0.63   |                        | 0.1    |               | = 50.1   | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | ( 1   | 19.01  | i i                        | 0.63   |                        | 0.1    | -             | = 56.12  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | ( <b>1</b>                                    | 18.15  | i i                        | 0.63   |                        | 0.1    | <b>-</b>      | = 55.71  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | ( <u> </u>                                    | 13.91  | 1                          | 0.63   |                        | 0.1    | -             | = 53.71  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | ( <b>1</b>                                    | 04.39  |                            | 0.63   |                        | 0.1    | <b>-</b>      | = 49.22  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | <u>با</u>                                     | 92.85  | 1                          | 0.63   |                        | 0.1    | -             | = 43.78  | (79)         |
| Southwest <sub>0</sub>   | .9x 0.77  | x  | 10.8  | ;  | ( (   | 69.27  | 1                          | 0.63   |                        | 0.1    | =             | = 32.66  | (79)         |
| Sout <mark>hwest</mark> 0  | .9x 0.77  | x  | 10.8  |  |   | 44.07  |                            | 0.63   | х                      | 0.1    | -             | = 20.78  | (79)         |
| Sout <mark>hwest</mark> 0  | .9x 0.77  | ×  | 10.8  | Ξ,   |   | 31.49  | 1                          | 0.63   | X                      | 0.1    | =             | = 14.85  | (79)         |
|  |   |  |   |  |   |  |                            |  | L                      |        |               |          |              |
| Solar gain   | s in watts, cal   | culated  | for each r  | nonth  |   |  | (83)m                      | = Sum(74)m .   | (82)m                  |        |               |          |              |
|  | .32 36.32   | 49.7   |   | 68.98  | 68.48   | 66.02  | 60.                        |  | 40.15                  | 25.54  | 18.25         | 5        | (83)         |
| Total gains  | s – internal an   | d solar  | (84)m = (7  | 73)m +   | (83)m   | , watts  | <u> </u>                   |  |                        |        | I             | _        |              |
| (84)m= 295   | 5.12 307.94   | 310.97   | 306.72 2  | 298.2  | 282.45  | 270.25   | 270                        | .02 271.84   | 274.47                 | 278.29 | 284.3         | 6        | (84)         |
| 7 Mean i   | nternal tempe   | erature  | (heating se   | eason)   |   |  |                            |  |                        |        | •             | _        |              |
|  | ure during he   |  |   | , i i i i i i i i i i i i i i i i i i i        | a area  | from Tab   | ole 9.                     | Th1 (°C)   |                        |        |               | 21       | (85)         |
|  | factor for gai  | • •  |   |  | -   |  | ,                          | ( -)   |                        |        |               |          | `            |
|  | an Feb  | Mar  | Apr   | May  | Jun   | Jul  | A                          | ug Sep   | Oct                    | Nov    | Dec           | 2        |              |
|  | 99 0.99   | 0.97   |   | 0.77   | 0.56  | 0.4  | 0.4                        | • ·  | 0.88                   | 0.98   | 0.99          |          | (86)         |
| Mean inte  | ernal temperat  | ture in l  | iving area  | I  | low etc                                       | $\frac{1}{2}$                                    | I<br>7 in T                |  |                        |        | I             |          |              |
| (87)m= 20  | i   | 20.85  |   | 20.99  | 21  | 21   | 2                          |  | 20.96                  | 20.83  | 20.69         | )        | (87)         |
|  |   |  |   |  |   | I  |                            |  | 20.00                  |        |               |          |              |
| Iamnoro  |   |  |   |  | NACHING                                       |  |                            | 1 1 1 2 1 2 1 2 1 2  |                        |        |               |          |              |
| ·  | ure during he   |  |   |  |   | í  | 1                          |  | 20 52                  | 20.52  | 20.51         |          | (88)         |
| · · · · · · · · · · · · · · · · · · ·  | 51 20.51  | ating p<br>20.51                                 |   | 20.52  | 20.53   | 20.53  | 20.                        |  | 20.52                  | 20.52  | 20.51         |          | (88)         |
| (88)m= 20<br>Utilisation   | .51 20.51   | 20.51  | 20.52 2<br>est of dwe   | 20.52<br>Illing, h                             | 20.53<br>2,m (s                               | 20.53  | 20.                        | 53 20.52   | 20.52                  | _I     | I             |          |              |
| (88)m= 20<br>Utilisation   | .51 20.51   | 20.51  | 20.52 2<br>est of dwe   | 20.52  | 20.53   | 20.53  | 20.                        | 53 20.52   | 20.52<br>0.86          | 0.97   | 20.51<br>0.99 |          | (88)<br>(89) |
| (88)m= 20<br>Utilisation<br>(89)m= 0.  | .51 20.51   | 20.51<br>ins for r<br>0.96                       | 20.52 2<br>est of dwe<br>0.89   | 20.52<br>Illing, h<br>0.73                     | 20.53<br>2,m (so<br>0.52                      | 20.53<br>ee Table<br>0.36                        | 20.9<br>9a)<br>0.3         | 53     20.52       8     0.58  | 0.86                   | _I     | I             |          |              |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte                           | 51 20.51<br>1 factor for gai  | 20.51<br>ins for r<br>0.96                       | 20.52 2<br>est of dwe<br>0.89 he rest of                                | 20.52<br>Illing, h<br>0.73                     | 20.53<br>2,m (so<br>0.52                      | 20.53<br>ee Table<br>0.36                        | 20.9<br>9a)<br>0.3         | 53         20.52           8         0.58           to 7 in Tabl   | 0.86                   | _I     | I             |          |              |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte                           | 51 20.51<br>6 factor for gai<br>99 0.98<br>ernal temperat   | 20.51<br>ins for r<br>0.96<br>ture in t          | 20.52 2<br>est of dwe<br>0.89 he rest of                                | 20.52<br>Iling, h<br>0.73<br>dwellir           | 20.53<br>2,m (so<br>0.52<br>ng T2 (f          | 20.53<br>ee Table<br>0.36<br>follow ste          | 20.9<br>9a)<br>0.3         | 3         20.52           8         0.58           to 7 in Tabl           53         20.52                                     | 0.86<br>e 9c)<br>20.48 | 0.97   | 0.99          | 0.47     | (89)         |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte<br>(90)m= 20              | 51         20.51           a factor for gai           99         0.98           ernal temperation           12         20.2 | 20.51<br>ins for r<br>0.96<br>ture in t<br>20.32 | 20.52     2       est of dwe       0.89                                 | 20.52<br>Illing, h<br>0.73<br>dwellir<br>20.51 | 20.53<br>2,m (so<br>0.52<br>ng T2 (f<br>20.53 | 20.53<br>ee Table<br>0.36<br>follow ste<br>20.53 | 20.9<br>9a)<br>0.3<br>20.9 | 8         0.58           to 7 in Tabl           53         20.52   | 0.86<br>e 9c)<br>20.48 | 0.97   | 0.99          | <br><br> | (89)         |
| (88)m= 20<br>Utilisation<br>(89)m= 0.<br>Mean inte<br>(90)m= 20<br>Mean inte | 51 20.51<br>6 factor for gai<br>99 0.98<br>ernal temperat   | 20.51<br>ins for r<br>0.96<br>ture in t<br>20.32 | 20.52 2<br>est of dwe<br>0.89 4<br>he rest of<br>20.45 2<br>r the whole | 20.52<br>Illing, h<br>0.73<br>dwellir<br>20.51 | 20.53<br>2,m (so<br>0.52<br>ng T2 (f<br>20.53 | 20.53<br>ee Table<br>0.36<br>follow ste<br>20.53 | 20.9<br>9a)<br>0.3<br>20.9 | <ul> <li>20.52</li> <li>20.52</li> <li>8 0.58</li> <li>to 7 in Tabl</li> <li>53 20.52</li> <li>f</li> <li>fLA) × T2</li> </ul> | 0.86<br>e 9c)<br>20.48 | 0.97   | 0.99          | 0.47     | (89)         |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= 20.2                     |                              | 20.42      | 20.53              | 20.58     | 20.6       | 20.6     | 20.6        | 20.6         | 20.56                 | 20.4                            | 20.23      |                           | (93)  |
|---------------------------------|------------------------------|------------|--------------------|-----------|------------|----------|-------------|--------------|-----------------------|---------------------------------|------------|---------------------------|-------|
|                                 | neating req                  |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
|                                 | ne mean int<br>ion factor fo |            | •                  |           | ied at ste | ep 11 of | Table 9t    | o, so tha    | t Ti,m=(              | 76)m an                         | d re-calc  | culate                    |       |
| Ja                              |                              | Mar        | Apr                | May       | Jun        | Jul      | Aug         | Sep          | Oct                   | Nov                             | Dec        |                           |       |
|                                 | factor for g                 |            |                    | may       | ••••       | • •      |             | 000          | •••                   |                                 | 200        |                           |       |
| (94)m= 0.9                      |                              | 0.96       | 0.89               | 0.74      | 0.52       | 0.36     | 0.38        | 0.59         | 0.86                  | 0.97                            | 0.99       |                           | (94)  |
| Useful gai                      | ns, hmGm                     | , W = (94  | 4)m x (84          | 4)m       |            |          |             |              |                       |                                 |            |                           |       |
| (95)m= 291.                     | 89 301.9                     | 297.73     | 272.04             | 219.52    | 147.69     | 98.5     | 103.12      | 160.78       | 236.3                 | 270.11                          | 281.99     |                           | (95)  |
| Monthly av                      | verage exte                  | ernal tem  | perature           | from Ta   | able 8     |          |             |              |                       |                                 |            |                           |       |
| (96)m= 4.3                      |                              | 6.5        | 8.9                | 11.7      | 14.6       | 16.6     | 16.4        | 14.1         | 10.6                  | 7.1                             | 4.2        |                           | (96)  |
|                                 | rate for me                  | 1          | · · ·              |           | i          | - ,      |             |              | -                     |                                 |            | I                         |       |
| (97)m= 409.                     |                              | 355.23     | 292.22             | 222.47    | 147.78     | 98.51    | 103.12      | 161.08       | 249.27                | 335.19                          | 406.46     |                           | (97)  |
|                                 | ating require                | 1          |                    |           |            |          |             |              | <u> </u>              | <i>.</i>                        | 00.0       | l                         |       |
| (98)m= 87.4                     | 45 62.34                     | 42.78      | 14.54              | 2.19      | 0          | 0        | 0           | 0            | 9.65                  | 46.85                           | 92.6       | 050.4                     |       |
|                                 |                              |            |                    |           |            |          | lota        | l per year   | (kWh/year             | ) = Sum(9                       | 8)15,912 = | 358.4                     | (98)  |
| Space hea                       | ating require                | ement in   | kWh/m <sup>2</sup> | /year     |            |          |             |              |                       |                                 |            | 7.2                       | (99)  |
| 9a. Energy                      | requiremer                   | nts – Indi | vidual h           | eating s  | ystems i   | ncluding | micro-C     | HP)          |                       |                                 |            |                           |       |
| Space he                        | -                            |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
|                                 | f space hea                  |            |                    |           | mentary    | system   |             |              |                       |                                 |            | 0                         | (201) |
| Fraction of                     | f space hea                  | at from m  | nain syst          | em(s)     |            |          | (202) = 1 - | - (201) =    |                       |                                 |            | 1                         | (202) |
| Fraction of                     | f total hea <mark>ti</mark>  | ng from    | main sys           | stem 1    |            |          | (204) = (20 | 02) × [1 – ( | (203)] =              |                                 |            | 1                         | (204) |
| Eff <mark>icienc</mark> y       | of main s <mark>p</mark> a   | ace heat   | ing syste          | em 1      |            |          |             |              |                       |                                 |            | 89.9                      | (206) |
| Eff <mark>icienc</mark> y       | of seconda                   | ry/suppl   | ementar <u>;</u>   | y heating | g system   | n, %     |             |              |                       |                                 |            | 0                         | (208) |
| Ja                              | n Feb                        | Mar        | Apr                | May       | Jun        | Jul      | Aug         | Sep          | Oct                   | Nov                             | Dec        | kWh/ye                    | ear   |
| Space hea                       | ating require                | ement (c   | alculate           | d above)  | )          |          |             |              |                       |                                 |            |                           |       |
| 87.4                            | 45 62.34                     | 42.78      | 14.54              | 2.19      | 0          | 0        | 0           | 0            | 9.65                  | 46.85                           | 92.6       |                           |       |
| (211)m = {[                     | (98)m x (20                  | 04)] } x 1 | 00 ÷ (20           | )6)       |            |          |             |              |                       |                                 |            | -                         | (211) |
| 97.2                            | 69.34                        | 47.59      | 16.17              | 2.44      | 0          | 0        | 0           | 0            | 10.73                 | 52.12                           | 103        |                           |       |
|                                 |                              | •          |                    |           |            |          | Tota        | l (kWh/yea   | ar) =Sum(2            | 2 <b>11)</b> <sub>15,1012</sub> | .=         | 398.67                    | (211) |
| Space hea                       | ating fuel (s                | econdar    | y), kWh/           | month     |            |          |             |              |                       |                                 |            |                           |       |
| = {[(98)m x                     | (201)] } x 1                 | 00 ÷ (20   | 8)                 |           | r          |          |             |              |                       |                                 |            |                           |       |
| <mark>(215)m=</mark> 0          | 0                            | 0          | 0                  | 0         | 0          | 0        | 0           | 0            | 0                     | 0                               | 0          |                           | _     |
|                                 |                              |            |                    |           |            |          | Tota        | l (kWh/yea   | ar) =Sum(2            | 215) <sub>15,1012</sub>         | <u>_</u>   | 0                         | (215) |
| Water heat                      | -                            |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
| Output from                     |                              |            |                    |           | 00.40      | 0470     | 05.50       | 00.40        | 440.00                | 440.04                          | 400.00     | l                         |       |
|                                 |                              | 120.98     | 106.58             | 103.1     | 90.18      | 84.76    | 95.56       | 96.19        | 110.62                | 119.31                          | 128.98     |                           |       |
| Efficiency o                    |                              | r          | 07.07              | 00.70     | 007        | 00.7     | 0.07        | 00.7         | 00.05                 | 07.50                           | 00.04      | 86.7                      | (216) |
| (217)m= 87.9                    |                              | 87.51      | 87.07              | 86.76     | 86.7       | 86.7     | 86.7        | 86.7         | 86.95                 | 87.58                           | 88.01      |                           | (217) |
| Fuel for wa<br>(219)m = (       | •                            |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
| (219)m = 151.                   |                              | 138.24     | 122.41             | 118.82    | 104.01     | 97.76    | 110.21      | 110.94       | 127.22                | 136.24                          | 146.55     |                           |       |
| L                               |                              |            |                    |           |            |          |             |              |                       |                                 |            |                           |       |
|                                 |                              | -          |                    |           |            |          | Tota        | I = Sum(21   | 19a) <sub>112</sub> = |                                 |            | 1496.11                   | (219) |
| Annual tot                      | als                          | •          |                    |           |            |          | Tota        | I = Sum(2'   |                       | Nh/year                         |            | 1496.11<br><b>kWh/yea</b> |       |
| <b>Annual tot</b><br>Space heat |                              | ed, main   | system             | 1         |            |          | Tota        | I = Sum(2′   |                       | Wh/year                         |            |                           |       |

| Water heating fuel used                             |                           |                                   |        | 1496.11                        | ]      |
|---|---------------------------|-----------------------------------|--------|--------------------------------|--------|
| Electricity for pumps, fans and electric keep-hot   |                           |                                   |        |                                |        |
| mechanical ventilation - balanced, extract or posit | ive input from ou         | utside                            | 116.96 |                                | (230a) |
| central heating pump:                               |                           |                                   | 30     |                                | (230c) |
| boiler with a fan-assisted flue                     |                           |                                   | 45     |                                | (230e) |
| Total electricity for the above, kWh/year           |                           | sum of (230a)(230g) =             |        | 191.96                         | (231)  |
| Electricity for lighting                            |                           |                                   |        | 313.91                         | (232)  |
| 12a. CO2 emissions – Individual heating systems     | including micro-          | СНР                               |        |                                |        |
|   | <b>Energy</b><br>kWh/year | <b>Emission fac</b><br>kg CO2/kWh | ctor   | <b>Emissions</b><br>kg CO2/yea | ır     |
| Space heating (main system 1)                       | (211) x                   | 0.216                             | =      | 86.11                          | (261)  |
| Space heating (secondary)                           | (215) x                   | 0.519                             | =      | 0                              | (263)  |
| Water heating                                       | (219) x                   | 0.216                             | =      | 323.16                         | (264)  |
| Space and water heating                             | (261) + (262) + (26       | 63) + (264) =                     |        | 409.27                         | (265)  |
| Electricity for pumps, fans and electric keep-hot   | (231) x                   | 0.519                             | =      | 99.62                          | (267)  |
| Electricity for lighting                            | (232) x                   | 0.519                             | =      | 162.92                         | (268)  |
| Total CO2, kg/year                                  |                           | sum of (265)(271) =               |        | 6 <mark>71.81</mark>           | (272)  |
| Dwelling CO2 Emission Rate                          |                           | (272) ÷ (4) =                     |        | 13.49                          | (273)  |
| El rating (section 14)                              |                           |                                   |        | 91                             | (274)  |

|   |   |                                       | User D      | etails:      |                |                  |                       |                           |                                   |                     |
|---|---|---------------------------------------|-------------|--------------|----------------|------------------|-----------------------|---------------------------|-----------------------------------|---------------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 201   | Versio                                | n: 1.0.4.23 |              |                |                  |                       |                           |                                   |                     |
| Addross I   | 1 Bed Flat, 219-223                                     |                                       |             | Address:     |                | nh lunct         | ion I ON              |                           |                                   |                     |
| Address :<br>1. Overall dwelling dimen  |   | Columan                               |             | ne, Loug     | μηροιοαί       | JII JUIICI       | ION, LON              |                           |                                   |                     |
| Ground floor  |   |                                       | Area<br>5   |              | (1a) x         | Av. He           | <b>ight(m)</b><br>2.5 | (2a) =                    | Volume(m <sup>3</sup> )<br>129.25 | (3a)                |
| Total floor area TFA = (1a  | )+(1b)+(1c)+(1d)+(1e                                    | e)+(1n)                               | ) 5         | 51.7         | (4)            |                  |                       |                           |                                   |                     |
| Dwelling volume   | 129.25  | (5)                                   |             |              |                |                  |                       |                           |                                   |                     |
| 2. Ventilation rate:  |   |                                       |             |              |                |                  |                       |                           |                                   |                     |
| Number of chimneys<br>Number of open flues  |   | econdary<br>neating<br>0<br>0         | / · · ·     | 0<br>0       | ] = [<br>] = [ | <b>total</b> 0 0 |                       | 40 =<br>20 =              | m <sup>3</sup> per hour           | (6a)<br>(6b)        |
| Number of intermittent fan  |   | 0                                     |             | 0            |                | -                |                       | 10 =                      |                                   |                     |
|   | 5   |                                       |             |              | Ļ              | 0                |                       | l                         | 0                                 | (7a)                |
| Number of passive vents   |   |                                       |             |              | L              | 0                | <b>X</b> 1            | 10 =                      | 0                                 | (7b)                |
| Number of flueless gas fire   |   |                                       |             |              |                | 0                | x 4                   | <sup>40</sup> =<br>Air ch | 0<br>anges per ho                 | (7c)<br>ur          |
| Infiltration due to chimney   |   |                                       |             |              |                | 0                |                       | ÷ (5) =                   | 0                                 | (8)                 |
| <i>If a pressurisation test has be</i><br>Number of storeys in the<br>Additional infiltration<br>Structural infiltration: 0.2 | e dw <mark>elling</mark> (ns)<br>25 for steel or timber | frame or                              | 0.35 for    | masonr       | y constr       |                  |                       | •1]x0.1 =                 | 0<br>0<br>0                       | (9)<br>(10)<br>(11) |
| if both types of wall are pre<br>deducting areas of opening   | gs); if equal user 0.35                                 |                                       | -           |              |                |                  |                       |                           |                                   | _                   |
| If suspended wooden flo   | ,   | led) or 0.'                           | 1 (seale    | d), else     | enter 0        |                  |                       |                           | 0                                 | (12)                |
| If no draught lobby, ente   |   |                                       |             |              |                |                  |                       |                           | 0                                 | (13)                |
| Percentage of windows   | and doors draught st                                    | tripped                               |             | 0.25 - [0.2  | v (14) ± 1     | 001 -            |                       |                           | 0                                 | (14)                |
| Window infiltration   |   |                                       |             | (8) + (10) - |                | -                | + (15) -              |                           | 0                                 | (15)                |
| Air permeability value, c   | 150 expressed in cut                                    | nic metres                            |             |              |                |                  |                       | area                      | 0                                 | (16)<br>(17)        |
| If based on air permeabilit   |   |                                       | •           | •            | •              |                  | invelope              | uluu                      | 2<br>0.1                          | (17)                |
| Air permeability value applies  | •   |                                       |             |              |                | is being u       | sed                   | l                         | 0.1                               |                     |
| Number of sides sheltered   | I   |                                       |             |              |                |                  |                       |                           | 2                                 | (19)                |
| Shelter factor  |   |                                       |             | (20) = 1 - [ |                | 9)] =            |                       |                           | 0.85                              | (20)                |
| Infiltration rate incorporation   | -   |                                       |             | (21) = (18)  | x (20) =       |                  |                       |                           | 0.08                              | (21)                |
| Infiltration rate modified fo   |   | <u> </u>                              |             |              |                |                  |                       |                           |                                   |                     |
| Jan Feb N   | Mar Apr May   | Jun                                   | Jul         | Aug          | Sep            | Oct              | Nov                   | Dec                       |                                   |                     |
| Monthly average wind spe  |   | , , , , , , , , , , , , , , , , , , , |             |              |                |                  |                       | <u> </u>                  |                                   |                     |
| (22)m= 5.1 5 4  | 4.4 4.3   | 3.8                                   | 3.8         | 3.7          | 4              | 4.3              | 4.5                   | 4.7                       |                                   |                     |
| Wind Factor $(22a)m = (22)$   |   | , ,                                   |             |              |                |                  | 1                     | ·                         |                                   |                     |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08  | 0.95                                  | 0.95        | 0.92         | 1              | 1.08             | 1.12                  | 1.18                      |                                   |                     |

| Adjust    | ed infiltr              | ation rat  | e (allowi                 | ng for sl                             | nelter an                  | d wind s    | peed) =     | (21a) x                               | (22a)m          |             |             |           | _              |                |
|-----------|-------------------------|------------|---------------------------|---------------------------------------|----------------------------|-------------|-------------|---------------------------------------|-----------------|-------------|-------------|-----------|----------------|----------------|
|           | 0.11                    | 0.11       | 0.1                       | 0.09                                  | 0.09                       | 0.08        | 0.08        | 0.08                                  | 0.08            | 0.09        | 0.1         | 0.1       |                |                |
|           | late effe<br>echanica   |            | -                         | rate for t                            | the appli                  | cable ca    | se          |                                       |                 |             |             |           | 0.5            | (23a)          |
|           |                         |            |                           | endix N. (2                           | 23b) = (23a                | ) x Fmv (e  | equation (N | N5)), othe                            | rwise (23b      | ) = (23a)   |             |           | 0.5            | (23a)          |
|           |                         |            |                           |                                       | allowing f                 |             |             |                                       |                 | , (,        |             |           | 0.5            | (230)<br>(23c) |
|           |                         |            | -                         | -                                     | with hea                   |             |             |                                       |                 | 2h)m + (    | 23h) v ['   | 1 – (23c) | 73.1<br>÷ 1001 | (230)          |
| (24a)m=   | 0.24                    | 0.24       | 0.24                      | 0.23                                  | 0.23                       | 0.22        | 0.22        | 0.21                                  | 0.22            | 0.23        | 0.23        | 0.23      | ]              | (24a)          |
|           |                         |            |                           |                                       | without                    |             |             |                                       |                 |             |             |           | 1              |                |
| (24b)m=   |                         |            |                           | 0                                     |                            |             |             |                                       | 0               |             | 0           | 0         | 1              | (24b)          |
|           |                         |            | tract ver                 | L                                     | or positiv                 |             | /entilatio  | n from c                              | utside          |             |             |           | l              |                |
|           |                         |            |                           |                                       | c) = (23b                  | -           |             |                                       |                 | .5 × (23b   | <b>)</b> )  |           |                |                |
| (24c)m=   | 0                       | 0          | 0                         | 0                                     | 0                          | 0           | 0           | 0                                     | 0               | 0           | 0           | 0         |                | (24c)          |
| d) If     | natural                 | ventilatio | on or wh                  | ole hous                              | se positiv                 | e input     | ventilatio  | on from l                             | oft             |             |             |           | 1              |                |
|           | if (22b)n               | n = 1, th  | en (24d)                  | m = (22                               | b)m othe                   | rwise (2    | 4d)m = (    | 0.5 + [(2                             | 2b)m² x         | 0.5]        |             |           | 1              |                |
| (24d)m=   | 0                       | 0          | 0                         | 0                                     | 0                          | 0           | 0           | 0                                     | 0               | 0           | 0           | 0         |                | (24d)          |
|           | r                       | <u> </u>   |                           | · · · · · · · · · · · · · · · · · · · | ) or (24b                  | , ,         | , ,         | · · · · · · · · · · · · · · · · · · · | <u> </u>        |             | 1           | 1         | 1              |                |
| (25)m=    | 0.24                    | 0.24       | 0.24                      | 0.23                                  | 0.23                       | 0.22        | 0.22        | 0.21                                  | 0.22            | 0.23        | 0.23        | 0.23      |                | (25)           |
| 3. He     | at l <mark>osse</mark>  | s and he   | eat loss                  | oaramet                               | er:                        |             |             |                                       |                 |             |             |           |                |                |
|           | <b>NENT</b>             | Gros       |                           | Openir                                | -                          | Net Ar      |             | U-valu                                |                 | AXU         |             | k-value   |                | AXk            |
| \A/' - 1- | . <b>.</b>              | area       | (m²)                      | n                                     | 1 <sup>2</sup>             | A ,r        |             | W/m2                                  |                 | (W/I        | K)          | kJ/m²·l   | K              | kJ/K           |
|           | ws Type                 |            |                           |                                       |                            | 10.35       |             | [1/( 0.73 )-                          | Ļ               | 7.34        |             |           |                | (27)           |
|           | ws Type                 | e 2        |                           |                                       |                            | 4.51        |             | [1/( 0.73 )+                          | + 0.04] =       | 3.2         | 닐 .         |           |                | (27)           |
| Floor     |                         |            |                           |                                       |                            | 51.7        | ×           | 0.06                                  | =               | 3.102       |             |           |                | (28)           |
| Walls     | Type1                   | 19.7       | 75                        | 10.3                                  | 5                          | 9.4         | X           | 0.15                                  | = [             | 1.41        |             |           |                | (29)           |
| Walls     | Type2                   | 14.7       | 75                        | 4.51                                  |                            | 10.24       | x           | 0.15                                  | =               | 1.54        |             |           |                | (29)           |
| Walls     | Туре3                   | 20         | )                         | 0                                     |                            | 20          | x           | 0.15                                  | =               | 3           |             |           |                | (29)           |
| Total a   | area of e               | elements   | , m²                      |                                       |                            | 106.2       | 2           |                                       |                 |             |             |           |                | (31)           |
| Party     | wall                    |            |                           |                                       |                            | 20          | x           | 0                                     | =               | 0           |             |           |                | (32)           |
| Party     | ceiling                 |            |                           |                                       |                            | 51.7        |             |                                       |                 |             |             |           |                | (32b)          |
| Interna   | al wall **              |            |                           |                                       |                            | 77          |             |                                       |                 |             |             |           |                | (32c)          |
|           |                         |            |                           |                                       | indow U-va<br>Ils and part |             | ated using  | formula 1                             | /[(1/U-valu     | ie)+0.04] a | as given in | paragraph | n 3.2          |                |
| Fabric    | heat los                | ss, W/K :  | = S (A x                  | U)                                    |                            |             |             | (26)(30)                              | + (32) =        |             |             |           | 19.59          | (33)           |
| Heat c    | apacity                 | Cm = S(    | (A x k )                  |                                       |                            |             |             |                                       | ((28)           | (30) + (32  | 2) + (32a). | (32e) =   | 11299.9        | 9 (34)         |
| Therm     | al mass                 | parame     | eter (TMF                 | P = Cm -                              | ÷ TFA) in                  | ı kJ/m²K    |             |                                       | Indica          | tive Value  | : Medium    |           | 250            | (35)           |
|           | -                       |            | ere the de<br>tailed calc |                                       | e constructi               | ion are not | t known pr  | ecisely the                           | e indicative    | e values of | TMP in Ta   | able 1f   |                |                |
| Therm     | al bridg                | es : S (L  | x Y) cal                  | culated                               | using Ap                   | pendix ł    | <           |                                       |                 |             |             |           | 7.96           | (36)           |
|           | s of therma<br>abric he |            | are not kn                | own (36) :                            | = 0.05 x (3                | 1)          |             |                                       | ( <b>33</b> ) ± | (36) =      |             |           | 07 55          | (27)           |
|           |                         |            | alculated                 | month                                 | v                          |             |             |                                       |                 |             | 25)m x (5)  |           | 27.55          | (37)           |
| v Gritik  | Jan                     | Feb        | Mar                       | Apr                                   | y<br>May                   | Jun         | Jul         | Aug                                   | Sep             | Oct         | Nov         | Dec       | ]              |                |
|           | Jun                     |            |                           |                                       | Interv                     | Jun         |             | , lug                                 |                 |             |             |           | I              |                |

| (38)m=     | 10.36             | 10.27                | 10.18             | 9.72                       | 9.63           | 9.18        | 9.18              | 9.09  | 9.36         | 9.63                   | 9.82                   | 10        |         | (38)         |
|------------|-------------------|----------------------|-------------------|----------------------------|----------------|-------------|-------------------|---|--------------|------------------------|------------------------|-----------|---------|--------------|
| Heat tr    | ansfer o          | coefficier           | nt, W/K           |                            |                |             |                   |   | (39)m        | = (37) + (3            | 38)m                   |           |         |              |
| (39)m=     | 37.91             | 37.82                | 37.73             | 37.27                      | 37.18          | 36.73       | 36.73             | 36.64   | 36.91        | 37.18                  | 37.36                  | 37.54     |         |              |
| Heat lo    | oss para          | imeter (H            | HLP), W           | /m²K                       |                |             |                   |   |              | Average =<br>= (39)m ÷ |                        | 12 /12=   | 37.25   | (39)         |
| (40)m=     | 0.73              | 0.73                 | 0.73              | 0.72                       | 0.72           | 0.71        | 0.71              | 0.71  | 0.71         | 0.72                   | 0.72                   | 0.73      |         |              |
| Numbe      | er of day         | /s in moi            | nth (Tab          | le 1a)                     |                |             |                   |   |              | Average =              | Sum(40)1.              | 12 /12=   | 0.72    | (40)         |
|            | Jan               | Feb                  | Mar               | Apr                        | May            | Jun         | Jul               | Aug   | Sep          | Oct                    | Nov                    | Dec       |         |              |
| (41)m=     | 31                | 28                   | 31                | 30                         | 31             | 30          | 31                | 31  | 30           | 31                     | 30                     | 31        |         | (41)         |
|            |                   |                      |                   |                            |                |             |                   |   |              |                        |                        |           |         |              |
| 4. Wa      | iter heat         | ting enei            | rgy requ          | irement:                   |                |             |                   |   |              |                        |                        | kWh/ye    | ear:    |              |
| if TF      |                   |                      |                   | : [1 - exp                 | (-0.0003       | 949 x (TF   | FA -13.9          | )2)] + 0.(  | )013 x (     | TFA -13.               |                        | 74        |         | (42)         |
|            |                   |                      | ater usag         | ge in litre                | es per da      | iy Vd,av    | erage =           | (25 x N)  | + 36         |                        | 75                     | .53       |         | (43)         |
|            |                   | -                    |                   | usage by a<br>r day (all w |                | -           | -                 | to achieve  | a water us   | se target o            |                        |           |         |              |
| not more   |                   |                      |                   |                            |                |             | ,<br>             |   |              |                        |                        |           |         |              |
| Hot wate   | Jan<br>er usage i | Feb                  | Mar<br>day for ea | Apr<br>ach month           | May            | Jun         | Jul<br>Table 1c x | Aug (43)  | Sep          | Oct                    | Nov                    | Dec       |         |              |
|            | 83.08             | 80.06                | 77.04             | 74.02                      | 71             | 67.98       | 67.98             | 71  | 74.02        | 77.04                  | 80.06                  | 83.08     |         |              |
| (44)m=     | 03.00             | 00.00                | 77.04             | 74.02                      |                | 07.90       | 07.90             |   |              | Total = Su             |                        |           | 906.36  | (44)         |
| Energy o   | content of        | hot water            | used - cal        | lculated mo                | onthly $= 4$ . | 190 x Vd,r  | n x nm x D        | )<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>) |              |                        |                        |           | 000.00  | (,           |
| (45)m=     | 123.21            | 107.76               | 111.2             | 96.95                      | 93.02          | 80.27       | 74.38             | 85.36   | 86.37        | 10 <mark>0.66</mark>   | 109.88                 | 119.32    |         |              |
|            |                   |                      |                   |                            |                |             |                   |   |              | Total = Su             | m(45) <sub>112</sub> = | -         | 1188.38 | (45)         |
| lf instant | aneous w          | ater heatii          | ng at point       | t of use (no               | o hot water    | storage),   | enter 0 in        | boxes (46   | ) to (61)    | i                      | r                      |           |         |              |
| (46)m=     | 18.48<br>storage  | 16.16                | 16.68             | 14.54                      | 13.95          | 12.04       | 11.16             | 12.8  | 12.96        | 15.1                   | 16.48                  | 17.9      |         | (46)         |
|            | -                 |                      | includir          | ng any so                  | olar or W      | /WHRS       | storage           | within sa   | ame ves      | sel                    |                        | 180       |         | (47)         |
| -          |                   | . ,                  |                   | ank in dw                  |                |             | -                 |   |              |                        |                        | 100       |         | ()           |
| Otherw     | ise if no         | o stored             |                   | er (this ir                | -              |             |                   | • •   | ers) ente    | er '0' in (            | 47)                    |           |         |              |
|            | storage           |                      | eclared I         | oss facto                  | or is kno      | wn (kWł     | n/dav).           |   |              |                        |                        | 0         |         | (48)         |
|            |                   |                      | m Table           |                            |                |             | "aay).            |   |              |                        |                        | 0         |         | (40)         |
|            |                   |                      |                   | e, kWh/ye                  | ear            |             |                   | (48) x (49  | ) =          |                        |                        | 80        |         | (10)         |
| •••        |                   |                      | -                 | cylinder l                 |                | or is not   |                   |   |              |                        |                        |           |         | (00)         |
|            |                   | -                    |                   | rom Tabl                   | le 2 (kW       | h/litre/da  | ıy)               |   |              |                        | 0.                     | 01        |         | (51)         |
|            | -                 | leating s<br>from Ta | ee secti          | on 4.3                     |                |             |                   |   |              |                        |                        |           |         | (50)         |
|            |                   |                      | m Table           | 2b                         |                |             |                   |   |              |                        |                        | 87<br>.6  |         | (52)<br>(53) |
|            |                   |                      |                   | , kWh/ye                   | ear            |             |                   | (47) x (51)   | ) x (52) x ( | 53) =                  |                        | 97        |         | (54)         |
|            |                   | (54) in (5           | -                 | ,,,,                       |                |             |                   |   | (- ) (       |                        |                        | 97        |         | (55)         |
| Water      | storage           | loss cal             | culated           | for each                   | month          |             |                   | ((56)m = (  | 55) × (41)   | m                      |                        |           |         |              |
| (56)m=     | 30.09             | 27.18                | 30.09             | 29.12                      | 30.09          | 29.12       | 30.09             | 30.09   | 29.12        | 30.09                  | 29.12                  | 30.09     |         | (56)         |
|            | er contains       |                      | d solar sto       | nage, (57)                 | m = (56)m      | x [(50) – ( | H11)] ÷ (5        | 0), else (5   | 7)m = (56)   | m where (              | H11) is fro            | m Appendi | ix H    |              |
| (57)m=     | 30.09             | 27.18                | 30.09             | 29.12                      | 30.09          | 29.12       | 30.09             | 30.09   | 29.12        | 30.09                  | 29.12                  | 30.09     |         | (57)         |

| Primary circui                | •             |            |             |            | (FO) m    | (50) . 20   | SE (44)          |              |                           |              | 0           |             | (58) |
|-------------------------------|---------------|------------|-------------|------------|-----------|-------------|------------------|--------------|---------------------------|--------------|-------------|-------------|------|
| Primary circui<br>(modified b |               |            |             |            | · ·       | . ,         | • • •            |              | r thermo                  | stat)        |             |             |      |
| (59)m= 23.26                  | 21.01         | 23.26      | 22.51       | 23.26      | 22.51     | 23.26       | 23.26            | 22.51        | 23.26                     | 22.51        | 23.26       |             | (59) |
| Combi loss ca                 | alculated     | for each   | month       | (61)m =    | (60) ÷ 3  | 65 x (41    | )m               |              |                           |              |             |             |      |
| (61)m= 0                      | 0             | 0          | 0           | 0          | 0         | 0           | 0                | 0            | 0                         | 0            | 0           |             | (61) |
| Total heat req                | uired for     | water h    | eating ca   | alculated  | l for eac | h month     | (62)m =          | • 0.85 × (   | (45)m +                   | (46)m +      | (57)m +     | (59)m + (61 | 1)m  |
| (62)m= 176.56                 | 155.95        | 164.55     | 148.58      | 146.38     | 131.9     | 127.74      | 138.71           | 138.01       | 154.01                    | 161.51       | 172.68      |             | (62) |
| Solar DHW input               | calculated    | using App  | endix G o   | r Appendix | H (negati | ve quantity | y) (enter '0     | ' if no sola | r contribut               | ion to wate  | er heating) |             |      |
| (add additiona                | al lines if   | FGHRS      | and/or \    | NWHRS      | applies   | , see Ap    | pendix (         | G)           |                           | -            | -           |             |      |
| (63)m= 0                      | 0             | 0          | 0           | 0          | 0         | 0           | 0                | 0            | 0                         | 0            | 0           |             | (63) |
| Output from w                 | vater hea     | ater       |             |            |           |             |                  |              |                           |              |             |             |      |
| (64)m= 176.56                 | 155.95        | 164.55     | 148.58      | 146.38     | 131.9     | 127.74      | 138.71           | 138.01       | 154.01                    | 161.51       | 172.68      |             |      |
|                               |               |            |             |            |           |             | Out              | out from wa  | ater heate                | r (annual)₁  | 12          | 1816.58     | (64) |
| Heat gains fro                | m water       | heating    | , kWh/m     | onth 0.2   | 5 ´ [0.85 | × (45)m     | ı + (61)n        | n] + 0.8 >   | k [(46)m                  | + (57)m      | + (59)m     | ]           |      |
| (65)m= 83.65                  | 74.38         | 79.66      | 73.54       | 73.61      | 68        | 67.42       | 71.06            | 70.03        | 76.15                     | 77.84        | 82.36       |             | (65) |
| include (57)                  | m in cal      | culation   | of (65)m    | only if c  | ylinder i | s in the o  | dwelling         | or hot w     | ate <mark>r is f</mark> r | om com       | munity h    | eating      |      |
| 5. Internal g                 | ains (see     | e Table {  | 5 and 5a    | ):         |           |             |                  |              |                           |              |             |             |      |
| Met <mark>abolic</mark> gai   | ns (Table     | e 5), Wat  | ts          |            |           |             |                  |              |                           |              |             |             |      |
| Jan                           | Feb           | Mar        | Apr         | May        | Jun       | Jul         | Aug              | Sep          | Oct                       | Nov          | Dec         |             |      |
| (66)m= 87.01                  | 87.01         | 87.01      | 87.01       | 87.01      | 87.01     | 87.01       | 87.01            | 87.01        | 8 <mark>7.01</mark>       | 87.01        | 87.01       |             | (66) |
| Ligh <mark>ting g</mark> ains | (calcula      | ited in Ap | opendix     | L, equat   | ion L9 o  | r L9a), a   | lso see          | Table 5      |                           |              |             |             |      |
| (67)m= 18.24                  | 16.2          | 13.18      | 9.98        | 7.46       | 6.3       | 6.8         | 8.84             | 11.87        | 15.07                     | 17.59        | 18.75       |             | (67) |
| Appliances ga                 | ains (calc    | culated in | n Appeno    | dix L, eq  | uation L  | 13 or L1    | 3a), also        | o see Ta     | ble 5                     |              |             |             |      |
| (68)m= 151.65                 | 153.22        | 149.26     | 140.81      | 130.16     | 120.14    | 113.45      | 111.88           | 115.84       | 124.28                    | 134.94       | 144.96      |             | (68) |
| Cooking gains                 | s (calcula    | ated in A  | ppendix     | L, equa    | tion L15  | or L15a     | ), also se       | ee Table     | 5                         |              |             |             |      |
| (69)m= 31.7                   | 31.7          | 31.7       | 31.7        | 31.7       | 31.7      | 31.7        | 31.7             | 31.7         | 31.7                      | 31.7         | 31.7        |             | (69) |
| Pumps and fa                  | ins gains     | (Table     | 5a)         | -          | -         | -           | -                | -            | -                         |              |             |             |      |
| (70)m= 0                      | 0             | 0          | 0           | 0          | 0         | 0           | 0                | 0            | 0                         | 0            | 0           |             | (70) |
| Losses e.g. e                 | vaporatio     | on (nega   | tive valu   | es) (Tab   | ole 5)    | -           |                  |              |                           |              |             |             |      |
| (71)m= -69.61                 | -69.61        | -69.61     | -69.61      | -69.61     | -69.61    | -69.61      | -69.61           | -69.61       | -69.61                    | -69.61       | -69.61      |             | (71) |
| Water heating                 | ,<br>gains (1 | Fable 5)   | •           | •          | •         |             | •                | •            | •                         |              |             |             |      |
| (72)m= 112.43                 | 110.69        | 107.07     | 102.14      | 98.94      | 94.44     | 90.61       | 95.52            | 97.26        | 102.36                    | 108.11       | 110.7       |             | (72) |
| Total interna                 | I gains =     | -          |             |            | (66)      | )m + (67)n  | •<br>n + (68)m · | + (69)m + (  | (70)m + (7                | 1)m + (72)   | m           |             |      |
| (73)m= 331.43                 | 329.22        | 318.6      | 302.03      | 285.66     | 269.98    | 259.97      | 265.34           | 274.07       | 290.81                    | 309.75       | 323.51      |             | (73) |
| 6. Solar gain                 | s:            |            |             |            |           |             |                  |              |                           |              |             |             |      |
| Solar gains are               | calculated    | using sola | r flux from | Table 6a   | and assoc | iated equa  | ations to co     | onvert to th | ne applicat               | ole orientat | ion.        |             |      |
| Orientation <sup>.</sup>      | Arress F      | Factor     | Area        |            | Fli       | IX          |                  | a            |                           | FF           |             | Gains       |      |

| Orientation:   | Access Facto<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|----------------|--------------------------|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x | 0.77                     | x | 4.51       | x | 11.28            | x | 0.63           | x | 0.1            | = | 2.22         | (75) |
| Northeast 0.9x | 0.77                     | x | 4.51       | x | 22.97            | × | 0.63           | × | 0.1            | = | 4.52         | (75) |

|  |                |                   |                   |           | _                                     |               | -           | -            | _                   |                         |        |       |      |  |
|--|----------------|-------------------|-------------------|-----------|---------------------------------------|---------------|-------------|--------------|---------------------|-------------------------|--------|-------|------|--|
| Northeast 0  | 0              | x                 | 4.5               | 1         | ×                                     | 41.38         | X           | 0.63         | ×                   | 0.1                     | =      | 8.15  | (75) |  |
| Northeast 0  |                | X                 | 4.5               | 1         | x                                     | 67.96         | x           | 0.63         | x                   | 0.1                     | =      | 13.38 | (75) |  |
| Northeast 0  | .9x 0.77       | x                 | 4.5               | 1         | ×                                     | 91.35         | x           | 0.63         | x                   | 0.1                     | =      | 17.99 | (75) |  |
| Northeast 0  | .9x 0.77       | х                 | 4.5               | 1         | x                                     | 97.38         | x           | 0.63         | x                   | 0.1                     | =      | 19.18 | (75) |  |
| Northeast 0  | .9x 0.77       | x                 | 4.5               | 1         | x                                     | 91.1          | x           | 0.63         | x                   | 0.1                     | =      | 17.94 | (75) |  |
| Northeast 0  | .9x 0.77       | x                 | 4.5               | 1         | x                                     | 72.63         | x           | 0.63         | x                   | 0.1                     | =      | 14.3  | (75) |  |
| Northeast 0  | .9x 0.77       | x                 | 4.5               | 1         | ×                                     | 50.42         | x           | 0.63         | x                   | 0.1                     | =      | 9.93  | (75) |  |
| Northeast 0  | .9x 0.77       | x                 | 4.5               | 1         | x                                     | 28.07         | x           | 0.63         | x                   | 0.1                     | =      | 5.53  | (75) |  |
| Northeast 0  | .9x 0.77       | x                 | 4.5               | 1         | x                                     | 14.2          | x           | 0.63         | x                   | 0.1                     | =      | 2.8   | (75) |  |
| Northeast 0  | .9x 0.77       | x                 | 4.5               | 1         | ×                                     | 9.21          | x           | 0.63         | x                   | 0.1                     | =      | 1.81  | (75) |  |
| Southwest <sub>0</sub>   | .9x 0.77       | x                 | 10.3              | 35        | x                                     | 36.79         | ]           | 0.63         | x                   | 0.1                     | =      | 16.63 | (79) |  |
| Southwest <sub>0</sub>   | .9x 0.77       | x                 | 10.3              | 35        | x                                     | 62.67         | ]           | 0.63         | x                   | 0.1                     | =      | 28.32 | (79) |  |
| Southwest <sub>0</sub>   | .9x 0.77       | x                 | 10.3              | 35        | x                                     | 85.75         | ]           | 0.63         | x                   | 0.1                     | =      | 38.75 | (79) |  |
| Southwest <sub>0</sub>   | .9x 0.77       | x                 | 10.3              | 35        | x                                     | 106.25        | ]           | 0.63         | x                   | 0.1                     | =      | 48.01 | (79) |  |
| Southwest <sub>0</sub>   | .9x 0.77       | x                 | 10.3              | 35        | x                                     | 119.01        | ]           | 0.63         | x                   | 0.1                     | =      | 53.78 | (79) |  |
| Southwest <sub>0</sub>   | .9x 0.77       | x                 | 10.3              | 35        | x                                     | 118.15        | ]           | 0.63         | x                   | 0.1                     | =      | 53.39 | (79) |  |
| Southwest <sub>0</sub>   | .9x 0.77       | x                 | 10.3              | 35        | x                                     | 113.91        | ]           | 0.63         | x                   | 0.1                     | =      | 51.47 | (79) |  |
| Southwesto   | .9x 0.77       | x                 | 10.3              | 35        | ×                                     | 104.39        |             | 0.63         | x                   | 0.1                     | =      | 47.17 | (79) |  |
| Southwest0.9x       0.77       x       10.35       x       104.39       0.63       x       0.1       =       4         Southwest0.9x       0.77       x       10.35       x       92.85       0.63       x       0.1       =       4 |                |                   |                   |           |                                       |               |             |              |                     |                         |        |       | (79) |  |
| Southwest $_{0.9x}$ 0.77 x 10.35 x 104.39 0.63 x 0.1 = 47.17   |                |                   |                   |           |                                       |               |             |              |                     |                         |        |       |      |  |
| Southwest $0.9 \times 0.77$ x 10.35 x 92.85 0.63 x 0.1 = 41.96   |                |                   |                   |           |                                       |               |             |              |                     |                         |        |       |      |  |
|  |                |                   |                   |           |                                       |               |             |              |                     |                         |        |       |      |  |
|  |                |                   |                   |           |                                       |               |             |              |                     |                         |        |       |      |  |
| Sola <mark>r gain</mark> s   | s in watts, ca | alculated         | l for each        | n month   |                                       |               | (83)m       | n = Sum(74)m | <mark>(8</mark> 2)m |                         |        |       |      |  |
| (83)m= 18  | .85 32.84      | 46.9              | 61.39             | 71.76     | 72                                    | .56 69.41     | 61.         | 47 51.88     | 36.83               | 22.71                   | 16.04  |       | (83) |  |
| Total gains  | s – internal a | nd solar          | (84)m =           | (73)m     | + (83                                 | 3)m, watts    |             |              | -                   |                         |        |       |      |  |
| (84)m= 350   | 0.27 362.06    | 365.5             | 363.43            | 357.42    | 342                                   | 2.54 329.38   | 326         | .81 325.96   | 327.64              | 332.45                  | 339.55 |       | (84) |  |
| 7. Mean i  | nternal temp   | erature           | (heating          | season    | )                                     |               |             |              |                     |                         |        |       |      |  |
| Temperat   | ure during h   | eating p          | eriods in         | the livi  | ng a                                  | rea from Ta   | ble 9       | , Th1 (°C)   |                     |                         |        | 21    | (85) |  |
| Utilisatior  | factor for ga  | ains for l        | iving are         | a, h1,m   | ı (se                                 | e Table 9a)   | _           |              |                     |                         |        |       |      |  |
| Ji   | an Feb         | Mar               | Apr               | May       | J                                     | un Jul        | A           | ug Sep       | Oct                 | Nov                     | Dec    |       |      |  |
| (86)m= 0.  | 99 0.99        | 0.98              | 0.95              | 0.87      | 0.                                    | 67 0.49       | 0.5         | 51 0.75      | 0.94                | 0.99                    | 1      |       | (86) |  |
| Mean inte  | ernal tempera  | ature in          | living are        | ea T1 (fo | ollow                                 | steps 3 to    | 7 in T      | able 9c)     |                     |                         |        |       |      |  |
| (87)m= 20  | .44 20.51      | 20.63             | 20.79             | 20.93     | 20                                    | .99 21        | 2           | 1 20.98      | 20.85               | 20.62                   | 20.42  |       | (87) |  |
| Temperat   | ure during h   | eating p          | eriods in         | rest of   | dwe                                   | lling from Ta | -<br>able 9 | 9. Th2 (°C)  |                     |                         |        |       |      |  |
| (88)m= 20  |                | 20.31             | 20.32             | 20.32     | -                                     | .33 20.33     | 20.         | í́           | 20.32               | 20.32                   | 20.32  | ]     | (88) |  |
|  | factor for ga  | aine for          | rest of du        | velling   | ـــــــــــــــــــــــــــــــــــــ | ) (see Table  |             |              | Į                   | 1                       |        | 1     |      |  |
| (89)m= 0.9   |                | 0.98              | 0.94              | 0.83      | 0.                                    | <u> </u>      | 9a)<br>0.4  | 14 0.69      | 0.92                | 0.98                    | 0.99   | 1     | (89) |  |
|  |                |                   |                   |           |                                       |               |             |              |                     |                         | 5.00   | 1     |      |  |
|  | ernal tempera  | ature in<br>19.84 | the rest of 20.08 | 20.25     | <u> </u>                              | <u> </u>      | r –         | i            | 1                   | 10.04                   | 10 55  | 1     | (90) |  |
| (90)m= 19  | 00 19.00       | 19.04             | 20.08             | 20.25     | 20                                    | .33 20.33     | 20.         |              | 20.15               | 19.84<br>ring area ÷ (4 | 19.55  | 0.5   | (90) |  |
|  |                |                   |                   |           |                                       |               |             |              |                     | ing area - (4           | •, –   | 0.5   | (91) |  |

| Mean      | interna                | l temper  | ature (fo                           | r the wh              | ole dwe  | lling) = fl    | LA × T1     | + (1 – fL | .A) × T2    |                       |              |             |           |        |
|-----------|------------------------|-----------|-------------------------------------|-----------------------|----------|----------------|-------------|-----------|-------------|-----------------------|--------------|-------------|-----------|--------|
| (92)m=    | 20                     | 20.09     | 20.24                               | 20.44                 | 20.59    | 20.66          | 20.67       | 20.67     | 20.65       | 20.5                  | 20.23        | 19.99       |           | (92)   |
| · · · · · |                        |           | 1                                   |                       |          |                | m Table     |           | · · ·       | opriate               |              |             |           |        |
| (93)m=    | 20                     | 20.09     | 20.24                               | 20.44                 | 20.59    | 20.66          | 20.67       | 20.67     | 20.65       | 20.5                  | 20.23        | 19.99       |           | (93)   |
|           |                        | · ·       | uirement                            |                       |          |                |             |           |             | 1 <b>T</b> ' /'       | 70)          |             | 1-4-      |        |
|           |                        |           | ernal ter                           | •                     |          | ed at ste      | ep 11 of    | I able 9  | o, so tha   | t II,m=(              | 76)m an      | d re-calc   | ulate     |        |
| Γ         | Jan                    | Feb       | Mar                                 | Apr                   | May      | Jun            | Jul         | Aug       | Sep         | Oct                   | Nov          | Dec         |           |        |
| Utilisa   | tion fac               | tor for g | ains, hm                            | :                     |          |                |             |           |             |                       |              |             |           |        |
| (94)m=    | 0.99                   | 0.99      | 0.98                                | 0.94                  | 0.84     | 0.64           | 0.45        | 0.48      | 0.72        | 0.93                  | 0.98         | 0.99        |           | (94)   |
| г         | -                      |           | , W = (94                           | , <u>,</u>            |          |                |             |           |             |                       |              |             |           | ()     |
| (95)m=    | 347.26                 | 357.41    | 356.74                              | 342.12                | 301.83   | 219.45         | 149.17      | 156.05    | 234.48      | 303.43                | 326.22       | 337.14      |           | (95)   |
| г         | ly avera               | age exte  | ernal tem<br>6.5                    | perature<br>8.9       | 11.7     | able 8<br>14.6 | 16.6        | 16.4      | 14.1        | 10.6                  | 7.1          | 4.2         |           | (96)   |
| (96)m=    | -                      | _         |                                     |                       |          |                | =[(39)m :   | -         |             |                       | 7.1          | 4.2         |           | (00)   |
| (97)m=    | 595.33                 | 574.4     | 518.29                              | 430.06                | 330.66   | 222.59         | 149.38      | 156.36    | 241.72      | 368.1                 | 490.68       | 592.73      |           | (97)   |
| L         |                        |           |                                     | r each m              | nonth, k |                | h = 0.02    |           |             | )m] x (4 <sup>-</sup> | 1)m          |             |           |        |
| (98)m=    | 184.57                 | 145.81    | 120.19                              | 63.31                 | 21.45    | 0              | 0           | 0         | 0           | 48.12                 | 118.41       | 190.16      |           |        |
|           |                        |           |                                     |                       |          |                |             | Tota      | l per year  | (kWh/year             | ) = Sum(9    | 8)15,912 =  | 892.02    | (98)   |
| Space     | heatin                 | g require | ement in                            | kWh/m <sup>2</sup>    | /year    |                |             |           |             |                       |              |             | 17.25     | (99)   |
| 9b. Ene   | erdv rec               | uiremer   | nts – Cor                           | nmunity               | heating  | scheme         |             |           |             |                       |              |             |           |        |
|           |                        |           |                                     |                       |          |                | ater heat   | ing prov  | ided by     | a c <mark>omm</mark>  | unity sch    | neme.       |           | _      |
| Fraction  | n <mark>o</mark> f spa | ace heat  | from se                             | condary/              | /supplen | nentary l      | heating (   | Table 1   | 1) '0' if n | one                   |              |             | 0         | (301)  |
| Fractior  | n <mark>o</mark> f spa | ace heat  | from co                             | <mark>mmu</mark> nity | system   | 1 – (301       | 1) =        |           |             |                       |              |             | 1         | (302)  |
|           |                        | -         |                                     |                       |          |                | procedure a |           |             | up to four o          | other heat   | sources; ti | he latter |        |
|           |                        |           | s, geother <mark>r</mark><br>Commun |                       |          | rom powel      | r stations. | See Appel | ndix C.     |                       |              |             | 1         | (303a) |
|           |                        |           |                                     |                       | -        |                |             |           |             | (5                    |              | ``          | 1         |        |
|           |                        |           | heat fro                            |                       |          |                |             |           |             |                       | 02) x (303   | a) =        | 1         | (304a) |
| Factor f  | or cont                | rol and o | charging                            | method                | (Table 4 | 4c(3)) fo      | r commu     | unity hea | ating sys   | tem                   |              |             | 1         | (305)  |
| Distribu  | tion los               | s factor  | (Table 1                            | 2c) for c             | commun   | ity heatii     | ng syste    | m         |             |                       |              |             | 1         | (306)  |
| Space     | heating                | 9         |                                     |                       |          |                |             |           |             |                       |              |             | kWh/year  |        |
| Annual    | space                  | heating   | requirem                            | nent                  |          |                |             |           |             |                       |              |             | 892.02    |        |
| Space I   | neat fro               | m Comr    | munity h                            | eat pum               | р        |                |             |           | (98) x (30  | 04a) x (30            | 5) x (306) = | =           | 892.02    | (307a) |
| Efficien  | cy of se               | econdary  | y/supple                            | mentary               | heating  | system         | in % (fro   | m Table   | e 4a or A   | ppendix               | E)           |             | 0         | (308   |
| Space I   | neating                | require   | ment froi                           | m secon               | dary/su  | plemen         | tary syst   | em        | (98) x (30  | 01) x 100 -           | ÷ (308) =    |             | 0         | (309)  |
| Water I   |                        |           |                                     |                       |          |                |             |           |             |                       |              |             |           | _      |
|           |                        |           | equirem                             |                       |          |                |             |           |             |                       |              |             | 1816.58   |        |
|           |                        |           | ty schem<br>nunity he               |                       | )        |                |             |           | (64) x (30  | )3a) x (30            | 5) x (306) = | =           | 1816.58   | (310a) |
| Electric  | ity used               | d for hea | t distribu                          | ution                 |          |                |             | 0.01      | × [(307a).  | (307e) +              | · (310a)(    | 310e)] =    | 27.09     | (313)  |
| Cooling   | Syster                 | n Energ   | y Efficiei                          | ncy Ratio             | C        |                |             |           |             |                       |              |             | 0         | (314)  |
| Space of  | cooling                | (if there | is a fixe                           | d cooling             | g systen | n, if not e    | enter 0)    |           | = (107) ÷   | (314) =               |              |             | 0         | (315)  |

| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside                                     | 121.42                   | (330a) |
|--|--------------------------|--------|
| warm air heating system fans   | 0                        | (330b) |
| pump for solar water heating   | 0                        | (330g) |
| Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =  | 121.42                   | (331)  |
| Energy for lighting (calculated in Appendix L)   | 322.17                   | (332)  |
| Electricity generated by PVs (Appendix M) (negative quantity)  | -664.99                  | (333)  |
| Electricity generated by wind turbine (Appendix M) (negative quantity)   | 0                        | (334)  |
| 12b. CO2 Emissions – Community heating scheme  |                          |        |
| Energy Emission factor<br>kWh/year kg CO2/kWh  | Emissions<br>kg CO2/year |        |
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel | əl 364                   | (367a) |
| CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x 0.52  | 386.2                    | (367)  |
| Electrical energy for heat distribution [(313) x 0.52  | = 14.06                  | (372)  |
| Total CO2 associated with community systems (363)(366) + (368)(372)  | 400.26                   | (373)  |
| CO2 associated with space heating (secondary) (309) x 0  | = 0                      | (374)  |
| CO2 associated with water from immersion heater or instantaneous heater (312) × 0.52   | - 0                      | (375)  |
| Total CO2 associated with space and water heating (373) + (374) + (375) =  | 400.26                   | (376)  |
| CO2 associated with electricity for pumps and fans within dwelling (331)) × 0.52   | 63.02                    | (378)  |
| CO2 associated with electricity for lighting (332))) x 0.52  | 167.21                   | (379)  |
| Energy saving/generation technologies (333) to (334) as applicable Item 1 0.52 × 0.01 =  | -345.13                  | (380)  |
| Total CO2, kg/year sum of (376)(382) =   | 285.35                   | (383)  |
| Dwelling CO2 Emission Rate (383) ÷ (4) =   | 5.52                     | (384)  |
| El rating (section 14)   | 96.05                    | (385)  |

|   |                               |                         | User D           | etails:          |                |                 |                       |           |                                   |              |
|---|-------------------------------|-------------------------|------------------|------------------|----------------|-----------------|-----------------------|-----------|-----------------------------------|--------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 201               |                         |                  | Stroma<br>Softwa | re Ver         |                 |                       | Versio    | n: 1.0.4.23                       |              |
|   | 2 Bed Flat, 219-223           |                         |                  | Address:         |                | nh lunat        | ion I ON              |           |                                   |              |
| Address :<br>1. Overall dwelling dimer  |                               | Colunan                 | Jour La          | ne, Loug         | μοιοαί         | gn Junci        | ION, LOP              | NDON      |                                   |              |
| Ground floor  |                               |                         | Area             | . ,              | (1a) x         | Av. Hei         | <b>ight(m)</b><br>2.5 | (2a) =    | Volume(m <sup>3</sup> )<br>194.75 | (3a)         |
| Total floor area TFA = (1a  | )+(1b)+(1c)+(1d)+(1e          | e)+(1n)                 | ) 7              | 7.9              | (4)            |                 |                       |           |                                   |              |
| Dwelling volume   |                               |                         |                  |                  | (3a)+(3b)      | +(3c)+(3d       | l)+(3e)+              | .(3n) =   | 194.75                            | (5)          |
| 2. Ventilation rate:  |                               |                         |                  |                  |                |                 |                       |           |                                   |              |
| Number of chimneys  | heating h                     | econdary<br>neating     | / ·              | other            | 1 = [          | total           | x 4                   | 40 =      | m <sup>3</sup> per hour           | -            |
| Number of open flues  |                               | 0                       | ] ' [_<br>] + [_ | 0                | ] - L<br>] = Г | 0               |                       | 20 =      | 0                                 | (6a)<br>(6b) |
| Number of intermittent fan  | IS L                          |                         |                  |                  | 」<br>「         | 0               | <b>x</b> 1            | 10 =      | 0                                 | (7a)         |
| Number of passive vents   |                               |                         |                  |                  | F              | 0               | x 1                   | 10 =      | 0                                 | (7b)         |
| Number of flueless gas fire   | es                            |                         |                  |                  |                | 0               | x 4                   | 40 =      | 0                                 | (7c)         |
|   |                               |                         |                  |                  |                |                 |                       | Air ch    | ange <mark>s per</mark> ho        | ur           |
| Infiltration due to chimney   |                               |                         |                  |                  |                | 0               |                       | ÷ (5) =   | 0                                 | (8)          |
| If a pressurisation test has be<br>Number of storeys in the<br>Additional infiltration      | e dw <mark>elling</mark> (ns) |                         |                  |                  |                |                 |                       | -1]x0.1 = | 0                                 | (9)<br>(10)  |
| Structural infiltration: 0.2<br>if both types of wall are pre<br>deducting areas of opening | esent, use the value corres   |                         |                  |                  | •              | uction          |                       |           | 0                                 | (11)         |
| If suspended wooden flo   |                               | led) or 0. <sup>-</sup> | 1 (seale         | d), else         | enter 0        |                 |                       |           | 0                                 | (12)         |
| If no draught lobby, ente   | er 0.05, else enter 0         |                         |                  |                  |                |                 |                       |           | 0                                 | (13)         |
| Percentage of windows   | and doors draught st          | tripped                 |                  |                  |                |                 |                       |           | 0                                 | (14)         |
| Window infiltration   |                               |                         |                  | 0.25 - [0.2      | x (14) ÷ 1     | = [00           |                       |           | 0                                 | (15)         |
| Infiltration rate   |                               |                         |                  | (8) + (10) -     |                |                 |                       |           | 0                                 | (16)         |
| Air permeability value, o   |                               |                         | •                | •                |                | etre of e       | nvelope               | area      | 2                                 | (17)         |
| If based on air permeabilit   |                               |                         |                  |                  |                | :- <b>b</b> - : |                       |           | 0.1                               | (18)         |
| Air permeability value applies<br>Number of sides sheltered                                 |                               | s been done             | e or a deg       | iree all per     | meaning        | is being us     | seu                   | 1         | 2                                 | (19)         |
| Shelter factor  | ~                             |                         |                  | (20) = 1 - [     | 0.075 x (1     | 9)] =           |                       |           | 0.85                              | (20)         |
| Infiltration rate incorporation   | ng shelter factor             |                         |                  | (21) = (18)      | x (20) =       |                 |                       |           | 0.08                              | (21)         |
| Infiltration rate modified fo   | r monthly wind speed          | b                       |                  |                  |                |                 |                       | Į         |                                   |              |
| Jan Feb I   | Mar Apr May                   | Jun                     | Jul              | Aug              | Sep            | Oct             | Nov                   | Dec       |                                   |              |
| Monthly average wind spe  | ed from Table 7               |                         |                  |                  |                |                 |                       |           |                                   |              |
| (22)m= 5.1 5 4  | 4.9 4.4 4.3                   | 3.8                     | 3.8              | 3.7              | 4              | 4.3             | 4.5                   | 4.7       |                                   |              |
| Wind Factor (22a)m = (22  | )m ÷ 4                        |                         |                  |                  |                |                 |                       |           |                                   |              |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08                  | 0.95                    | 0.95             | 0.92             | 1              | 1.08            | 1.12                  | 1.18      |                                   |              |

| Adjust         | ed infiltr             | ation rat | e (allow                  | ing for sh                  | nelter an   | d wind s    | peed) =        | (21a) x                               | (22a)m       |                |             |           |            |                |
|----------------|------------------------|-----------|---------------------------|-----------------------------|-------------|-------------|----------------|---------------------------------------|--------------|----------------|-------------|-----------|------------|----------------|
|                | 0.11                   | 0.11      | 0.1                       | 0.09                        | 0.09        | 0.08        | 0.08           | 0.08                                  | 0.08         | 0.09           | 0.1         | 0.1       |            |                |
|                | ate ette<br>echanica   |           | -                         | rate for t                  | he appli    | cable ca    | se             |                                       |              |                |             |           | 0.5        | (23a)          |
|                |                        |           |                           | endix N, (2                 | 3b) = (23a  | ı) × Fmv (e | equation (I    | N5)) . othe                           | rwise (23b   | ) = (23a)      |             |           | 0.5<br>0.5 | (23a)<br>(23b) |
|                |                        |           |                           | iency in %                  |             |             |                |                                       |              | , ( ,          |             |           | 73.1       | (23c)          |
|                |                        |           |                           |                             | 0           |             |                |                                       | ,            | 2h)m + (       | 23h) x [    | 1 – (23c) | -          | (200)          |
| (24a)m=        |                        | 0.24      | 0.24                      | 0.23                        | 0.23        | 0.22        | 0.22           | 0.21                                  | 0.22         | 0.23           | 0.23        | 0.23      | . 100]     | (24a)          |
|                |                        | d mech    | L<br>anical ve            | I<br>entilation             | without     | heat rec    | L<br>coverv (N | L<br>MV) (24h                         | (22)         | L<br>2b)m + () | L<br>23b)   |           |            |                |
| (24b)m=        | r                      | 0         | 0                         | 0                           | 0           | 0           | 0              | 0                                     | 0            | 0              | 0           | 0         |            | (24b)          |
|                |                        | use ex    | tract ver                 | ntilation of                | or positiv  | re input v  | ventilatio     | n from o                              | utside       |                |             |           |            |                |
| ,              |                        |           |                           | then (24                    | •           | •           |                |                                       |              | .5 × (23b      | <b>)</b> )  |           |            |                |
| (24c)m=        | - 0                    | 0         | 0                         | 0                           | 0           | 0           | 0              | 0                                     | 0            | 0              | 0           | 0         |            | (24c)          |
| ,              |                        |           |                           | ole hous                    |             | •           |                |                                       |              | -              | -           |           |            |                |
|                | <u>, ,</u>             | r         | r , ,                     | m = (22                     | <i>.</i>    | , ,         | ,<br>          | <u> </u>                              | <u> </u>     | 0.5]           |             |           | l          |                |
| (24d)m=        | 0                      | 0         | 0                         | 0                           | 0           | 0           | 0              | 0                                     | 0            | 0              | 0           | 0         |            | (24d)          |
|                |                        |           | î .                       | nter (24a                   | , <u>,</u>  | , <u> </u>  | , <u>,</u>     | · · · · · · · · · · · · · · · · · · · | 1 Ó          |                | i           | i         | I          |                |
| (25)m=         | 0.24                   | 0.24      | 0.24                      | 0.23                        | 0.23        | 0.22        | 0.22           | 0.21                                  | 0.22         | 0.23           | 0.23        | 0.23      |            | (25)           |
| 3. He          | at l <mark>osse</mark> | s and he  | eat loss                  | paramete                    | er:         |             |                |                                       |              |                |             |           |            |                |
|                | /IENT                  | Gro       |                           | Openin                      |             | Net Ar      |                | U-val                                 |              | AXU            |             | k-value   |            | AXk            |
| \\ <i>\\</i> : | т                      | area      | (m²)                      | m                           | 12          | A ,n        |                | W/m2                                  |              | (VV/I          | K)          | kJ/m²·ł   | ς          | kJ/K           |
|                | ws Type                |           |                           |                             |             | 9.45        |                | /[1/( 0.73 )-                         |              | 6.7            |             |           |            | (27)           |
|                | ws Type                |           |                           |                             |             | 3.15        | ×1/            | /[1/( 0.73 )-                         | + 0.04] =    | 2.23           | ╘╴,         |           |            | (27)           |
| Walls          |                        | 10.0      | 05                        | 9.45                        |             | 0.6         | ×              | 0.15                                  | =            | 0.09           | L ļ         |           | ╡┝         | (29)           |
| Walls          |                        | 14.       | 5                         | 0                           |             | 14.5        | ×              | 0.15                                  | =            | 2.18           |             |           | $\_$ $\_$  | (29)           |
| Walls          |                        | 5.3       |                           | 3.15                        |             | 2.2         | x              | 0.15                                  | =            | 0.33           |             |           |            | (29)           |
| Total a        | area of e              | lements   | s, m²                     |                             |             | 29.9        |                |                                       |              |                |             |           |            | (31)           |
| Party          | wall                   |           |                           |                             |             | 32          | x              | 0                                     | =            | 0              |             |           |            | (32)           |
| Party          | wall                   |           |                           |                             |             | 33          | x              | 0                                     | =            | 0              |             |           |            | (32)           |
| Party f        | loor                   |           |                           |                             |             | 77.9        |                |                                       |              |                | [           |           |            | (32a)          |
| Party of       | ceiling                |           |                           |                             |             | 77.9        |                |                                       |              |                | [           |           |            | (32b)          |
| Interna        | al wall **             |           |                           |                             |             | 82.5        |                |                                       |              |                | [           |           |            | (32c)          |
|                |                        |           |                           | effective wi<br>nternal wal |             |             | ated using     | g formula 1                           | /[(1/U-valı  | ıe)+0.04] a    | as given in | paragraph | 3.2        |                |
| Fabric         | heat los               | s, W/K    | = S (A x                  | U)                          |             |             |                | (26)(30)                              | ) + (32) =   |                |             |           | 11.53      | (33)           |
| Heat c         | apacity                | Cm = S    | (A x k )                  |                             |             |             |                |                                       | ((28).       | (30) + (32     | 2) + (32a). | (32e) =   | 15893.     | 1 (34)         |
| Therm          | al mass                | parame    | eter (TMI                 | <sup>-</sup> = Cm ÷         | - TFA) in   | n kJ/m²K    |                |                                       | Indica       | tive Value     | : Medium    |           | 250        | (35)           |
|                | -                      |           | ere the de<br>tailed calc | etails of the<br>ulation.   | constructi  | ion are not | t known pi     | recisely the                          | e indicative | e values of    | TMP in T    | able 1f   |            |                |
| Therm          | al bridg               | es : S (L | x Y) cal                  | culated (                   | using Ap    | pendix ł    | <              |                                       |              |                |             |           | 6.02       | (36)           |
|                |                        |           | are not kr                | nown (36) =                 | = 0.05 x (3 | 1)          |                |                                       | (0.0)        | (0.0)          |             | 1         |            | <b></b> .      |
| i otal f       | abric he               | at IOSS   |                           |                             |             |             |                |                                       | (33) +       | (36) =         |             |           | 17.55      | (37)           |

| Ventila   | tion hea           | at loss ca          | alculated         | monthl                   | у                | -                  |                   |             | (38)m                 | = 0.33 × (           | 25)m x (5)             |         |         |      |
|-----------|--------------------|---------------------|-------------------|--------------------------|------------------|--------------------|-------------------|-------------|-----------------------|----------------------|------------------------|---------|---------|------|
|           | Jan                | Feb                 | Mar               | Apr                      | May              | Jun                | Jul               | Aug         | Sep                   | Oct                  | Nov                    | Dec     |         |      |
| (38)m=    | 15.61              | 15.47               | 15.34             | 14.65                    | 14.52            | 13.83              | 13.83             | 13.7        | 14.11                 | 14.52                | 14.79                  | 15.06   |         | (38) |
| Heat tr   | ansfer c           | coefficie           | nt, W/K           |                          |                  |                    |                   |             | (39)m                 | = (37) + (3          | 38)m                   |         |         |      |
| (39)m=    | 33.16              | 33.03               | 32.89             | 32.21                    | 32.07            | 31.39              | 31.39             | 31.25       | 31.66                 | 32.07                | 32.34                  | 32.62   |         |      |
|           |                    |                     |                   |                          |                  |                    |                   | •           |                       |                      | Sum(39)1.              | 12 /12= | 32.17   | (39) |
|           | <u> </u>           | · · ·               | HLP), W           | 1                        |                  |                    |                   | 1           | · · ·                 | = (39)m ÷            |                        |         |         |      |
| (40)m=    | 0.43               | 0.42                | 0.42              | 0.41                     | 0.41             | 0.4                | 0.4               | 0.4         | 0.41                  | 0.41                 | 0.42                   | 0.42    | 0.44    |      |
| Numbe     | er of day          | s in mo             | nth (Tab          | le 1a)                   |                  |                    |                   |             | ,                     | <pre>Average =</pre> | Sum(40)1.              | 12/12=  | 0.41    | (40) |
|           | Jan                | Feb                 | Mar               | Apr                      | May              | Jun                | Jul               | Aug         | Sep                   | Oct                  | Nov                    | Dec     |         |      |
| (41)m=    | 31                 | 28                  | 31                | 30                       | 31               | 30                 | 31                | 31          | 30                    | 31                   | 30                     | 31      |         | (41) |
|           |                    |                     | !                 | ļ                        | !                |                    | !                 | !           |                       |                      |                        | I       |         |      |
| 4 Wa      | ater heat          | tina ener           | rav reau          | irement:                 |                  |                    |                   |             |                       |                      |                        | kWh/ye  | ar.     |      |
|           |                    | ing ono             | igy ioqu          |                          |                  |                    |                   |             |                       |                      |                        |         |         |      |
|           |                    |                     |                   | / [1 _ ovn               |                  |                    | -130              | )2)] + 0.(  | 1013 v ( <sup>-</sup> | FEA _13              |                        | 42      |         | (42) |
|           | A £ 13.9           |                     | + 1.70 X          | r [i - exh               | (-0.0003         | 949 X (11          | A -13.9           | )2)] + 0.0  | JU13 X (              | IFA - 13.            | .9)                    |         |         |      |
|           |                    |                     |                   |                          |                  |                    |                   | (25 x N)    |                       |                      |                        | .72     |         | (43) |
|           |                    | -                   |                   | usage by<br>r day (all w |                  | -                  | -                 | to achieve  | a water us            | se target o          | f                      |         |         |      |
|           |                    |                     |                   |                          |                  |                    | ·                 |             | 0.00                  | Ort                  | Neu                    | Dea     |         |      |
| Hot wate  | Jan<br>er usage il | Feb<br>n litres per | Mar<br>day for ea | Apr<br>ach month         | May<br>Vd.m.= fa | Jun<br>ctor from T | Jul<br>Table 1c x | Aug (43)    | Sep                   | Oct                  | Nov                    | Dec     |         |      |
| (44)m=    | 100.89             | ,<br>97.22          | 93.55             | 89.88                    | 86.21            | 82.55              | 82.55             | 86.21       | 89.88                 | 9 <mark>3.55</mark>  | 97.22                  | 100.89  |         |      |
| (44)111-  | 100.03             | 51.22               | 93.33             | 03.00                    | 00.21            | 02.00              | 02.00             | 00.21       |                       |                      | m(44) <sub>112</sub> = |         | 1100.62 | (44) |
| Energy (  | content of         | hot water           | used - ca         | lculated m               | onthly $= 4$ .   | 190 x Vd,r         | n x nm x E        | OTm / 3600  |                       |                      | · · ·                  |         |         |      |
| (45)m=    | 149.62             | 130.86              | 135.03            | 117.72                   | 112.96           | 97.47              | 90.32             | 103.65      | 104.89                | 12 <mark>2.24</mark> | 133.43                 | 144.9   |         |      |
|           |                    |                     |                   |                          |                  |                    |                   |             |                       | Fotal = Su           | m(45) <sub>112</sub> = | -       | 1443.08 | (45) |
| lf instan | taneous w          | ater heati          | ng at point       | t of use (no             | o hot water      | r storage),        | enter 0 in        | boxes (46   | ) to (61)             |                      | -                      |         |         |      |
|           | 22.44              |                     | 20.25             | 17.66                    | 16.94            | 14.62              | 13.55             | 15.55       | 15.73                 | 18.34                | 20.01                  | 21.73   |         | (46) |
|           | storage            |                     | includir          |                          | alar ar M        |                    | storada           | within sa   | me ves                | ما                   |                        | 400     |         | (47) |
| 0         |                    | ,                   |                   | ank in dw                |                  |                    | •                 |             |                       | 501                  |                        | 180     |         | (47) |
|           | •                  | -                   |                   |                          | -                |                    |                   | ombi boil   | ers) ente             | er '0' in (          | 47)                    |         |         |      |
|           | storage            |                     |                   | ,                        |                  |                    |                   |             | ,                     | ,                    |                        |         |         |      |
| a) If m   | nanufact           | urer's de           | eclared I         | oss facto                | or is kno        | wn (kWł            | n/day):           |             |                       |                      |                        | 0       |         | (48) |
| Tempe     | erature fa         | actor fro           | m Table           | 2b                       |                  |                    |                   |             |                       |                      |                        | 0       |         | (49) |
|           |                    |                     | -                 | e, kWh/ye                |                  |                    |                   | (48) x (49) | ) =                   |                      | 1                      | 80      |         | (50) |
| ,         |                    |                     |                   | cylinder l<br>rom Tabl   |                  |                    |                   |             |                       |                      |                        | 04      |         | (54) |
|           |                    | -                   | ee secti          |                          |                  |                    | iy)               |             |                       |                      | 0.                     | 01      |         | (51) |
|           | e factor           | -                   |                   |                          |                  |                    |                   |             |                       |                      | 0.                     | 87      |         | (52) |
| Tempe     | erature fa         | actor fro           | m Table           | 2b                       |                  |                    |                   |             |                       |                      | 0                      | .6      |         | (53) |
| Energy    | / lost fro         | m water             | · storage         | e, kWh/ye                | ear              |                    |                   | (47) x (51) | ) x (52) x (          | 53) =                | 0.                     | 97      |         | (54) |
| Enter     | (50) or (          | (54) in (5          | 55)               |                          |                  |                    |                   |             |                       |                      | 0.                     | 97      |         | (55) |
| Water     | storage            | loss cal            | culated           | for each                 | month            |                    |                   | ((56)m = (  | 55) × (41)            | m                    |                        |         |         |      |
| (56)m=    | 30.09              | 27.18               | 30.09             | 29.12                    | 30.09            | 29.12              | 30.09             | 30.09       | 29.12                 | 30.09                | 29.12                  | 30.09   |         | (56) |

| If cylinder conta            | ins dedicate  | d solar sto | rage, (57)ı | m = (56)m               | x [(50) – ( | H11)] ÷ (5               | 0), else (5           | 7)m = (56)   | m where (                 | H11) is fro | m Append    | ix H          |      |
|------------------------------|---------------|-------------|-------------|-------------------------|-------------|--------------------------|-----------------------|--------------|---------------------------|-------------|-------------|---------------|------|
| (57)m= 30.09                 | 27.18         | 30.09       | 29.12       | 30.09                   | 29.12       | 30.09                    | 30.09                 | 29.12        | 30.09                     | 29.12       | 30.09       |               | (57) |
| Primary circu                | uit loss (ar  | nnual) fro  | om Table    | e 3                     |             |                          |                       |              |                           |             | 0           |               | (58) |
| Primary circu                | uit loss cal  | culated     | for each    | month (                 | 59)m = (    | (58) ÷ 36                | 65 × (41)             | m            |                           |             |             |               |      |
| (modified                    | by factor f   | rom Tab     | le H5 if t  | here is s               | solar wat   | ter heatii               | ng and a              | cylinde      | r thermo                  | stat)       |             |               |      |
| (59)m= 23.26                 | 6 21.01       | 23.26       | 22.51       | 23.26                   | 22.51       | 23.26                    | 23.26                 | 22.51        | 23.26                     | 22.51       | 23.26       |               | (59) |
| Combi loss o                 | alculated     | for each    | month (     | (61)m =                 | (60) ÷ 36   | 65 × (41)                | )m                    |              | -                         |             |             |               |      |
| (61)m= 0                     | 0             | 0           | 0           | 0                       | 0           | 0                        | 0                     | 0            | 0                         | 0           | 0           |               | (61) |
| Total heat re                | quired for    | water h     | eating ca   | alculated               | for eac     | h month                  | (62)m =               | 0.85 × (     | (45)m +                   | (46)m +     | (57)m +     | (59)m + (61)m |      |
| (62)m= 202.9                 | 7 179.05      | 188.38      | 169.36      | 166.31                  | 149.11      | 143.68                   | 157                   | 156.52       | 175.59                    | 185.06      | 198.25      |               | (62) |
| Solar DHW inpu               | ut calculated | using App   | endix G or  | Appendix                | H (negati   | ve quantity              | /) (enter '0          | ' if no sola | r contribut               | ion to wate | er heating) |               |      |
| (add addition                | nal lines if  | FGHRS       | and/or V    | WWHRS                   | applies     | , see Ap                 | pendix C              | G)           |                           | -           |             |               |      |
| (63)m= 0                     | 0             | 0           | 0           | 0                       | 0           | 0                        | 0                     | 0            | 0                         | 0           | 0           |               | (63) |
| Output from                  | water hea     | ter         |             |                         |             |                          |                       |              |                           |             |             |               |      |
| (64)m= 202.9                 | 7 179.05      | 188.38      | 169.36      | 166.31                  | 149.11      | 143.68                   | 157                   | 156.52       | 175.59                    | 185.06      | 198.25      |               |      |
|                              | -             |             |             |                         |             |                          | Outp                  | out from wa  | ater heate                | r (annual)₁ | 12          | 2071.28       | (64) |
| Hea <mark>t gains f</mark> i | om water      | heating     | kWh/m       | onth 0.2                | 5´[0.85     | × (45)m                  | <mark>+ (61)</mark> m | n] + 0.8 >   | k [(46)m                  | + (57)m     | + (59)m     | ]             |      |
| (65)m= 92.43                 | 82.06         | 87.58       | 80.45       | 80.24                   | 73.72       | 72.72                    | 77.15                 | 76.18        | 83.33                     | 85.67       | 90.86       |               | (65) |
| in <mark>clude</mark> (5     | 7)m in cal    | culation    | of (65)m    | only i <mark>f</mark> c | ylinder i   | s in th <mark>e</mark> o | dwelling              | or hot w     | ate <mark>r is f</mark> r | om com      | munity h    | eating        |      |
| 5. Internal                  | gains (see    | e Table {   | 5 and 5a)   | ):                      |             |                          |                       |              |                           |             |             |               |      |
| Metabolic ga                 | ins (Table    | e 5), Wat   | ts          |                         |             |                          |                       |              |                           |             |             |               |      |
| Jan                          |               | Mar         | Apr         | Мау                     | Jun         | Jul                      | Aug                   | Sep          | Oct                       | Nov         | Dec         |               |      |
| (66)m= 121.0                 | 9 121.09      | 121.09      | 121.09      | 121.09                  | 121.09      | 121.09                   | 121.09                | 121.09       | 121.09                    | 121.09      | 121.09      |               | (66) |
| Lighting gair                | is (calcula   | ted in Ap   | opendix     | L, equat                | ion L9 o    | r L9a), a                | lso see               | Table 5      |                           |             |             |               |      |
| (67)m= 27.01                 | 23.99         | 19.51       | 14.77       | 11.04                   | 9.32        | 10.07                    | 13.09                 | 17.57        | 22.31                     | 26.04       | 27.76       |               | (67) |
| Appliances g                 | ains (calc    | ulated ir   | Append      | dix L, eq               | uation L    | 13 or L1                 | 3a), also             | see Ta       | ble 5                     |             | _           |               |      |
| (68)m= 215                   | 217.23        | 211.6       | 199.64      | 184.53                  | 170.33      | 160.84                   | 158.61                | 164.23       | 176.2                     | 191.31      | 205.51      |               | (68) |
| Cooking gair                 | ns (calcula   | ated in A   | ppendix     | L, equat                | tion L15    | or L15a)                 | ), also se            | e Table      | 5                         |             |             |               |      |
| (69)m= 35.11                 | 35.11         | 35.11       | 35.11       | 35.11                   | 35.11       | 35.11                    | 35.11                 | 35.11        | 35.11                     | 35.11       | 35.11       |               | (69) |
| Pumps and f                  | ans gains     | (Table §    | 5a)         |                         |             |                          |                       |              |                           |             |             |               |      |
| (70)m= 0                     | 0             | 0           | 0           | 0                       | 0           | 0                        | 0                     | 0            | 0                         | 0           | 0           |               | (70) |
| Losses e.g.                  | evaporatio    | n (nega     | tive valu   | es) (Tab                | le 5)       |                          |                       |              |                           |             |             |               |      |
| (71)m= -96.8                 | 7 -96.87      | -96.87      | -96.87      | -96.87                  | -96.87      | -96.87                   | -96.87                | -96.87       | -96.87                    | -96.87      | -96.87      |               | (71) |
| Water heatir                 | ig gains (1   | rable 5)    |             |                         |             |                          |                       |              |                           |             |             |               |      |
| (72)m= 124.2                 | <u> </u>      | , 117.72    | 111.73      | 107.85                  | 102.38      | 97.74                    | 103.69                | 105.81       | 112                       | 118.99      | 122.12      |               | (72) |
| Total intern                 | al gains =    |             |             |                         | (66)        | u<br>m + (67)m           | n + (68)m +           | - (69)m + (  | (70)m + (7                | 1)m + (72)  | m           |               |      |
| (73)m= 425.5                 |               | 408.16      | 385.47      | 362.75                  | 341.36      | 327.98                   | 334.72                | 346.94       | 369.84                    | 395.66      | 414.72      |               | (73) |
| 6. Solar gai                 | ns:           | 1           | 1           |                         |             |                          |                       |              |                           |             |             |               |      |
| Solar gains ar               |               | using sola  | r flux from | Table 6a                | and assoc   | iated equa               | itions to co          | nvert to th  | e applicat                | le orientat | ion.        |               |      |
| Orientation:                 |               |             | Area        |                         | Flu         |                          |                       | g_           |                           | FF          |             | Gains         |      |
|                              | Table 6d      |             | m²          |                         | Tal         | ble 6a                   | Т                     | able 6b      | Та                        | able 6c     |             | (W)           |      |

| Northeast 0.9x 0.77 × 3.15 × 11.28 × 0.63 × 0.1 = 1.55 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 22.97 × 0.63 × 0.1 = 5.69 (FG)<br>Northeast 0.9x 0.77 × 3.15 × 14.138 × 0.63 × 0.1 = 5.69 (FG)<br>Northeast 0.9x 0.77 × 3.15 × 0.135 × 0.13 × 0.63 × 0.1 = 1.26 (FG)<br>Northeast 0.9x 0.77 × 3.15 × 0.135 × 0.63 × 0.1 = 1.26 (FG)<br>Northeast 0.9x 0.77 × 3.15 × 0.11 × 0.63 × 0.61 = 1.225 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.11 × 0.63 × 0.1 = 1.25 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.11 × 0.63 × 0.1 = 1.25 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.11 × 0.63 × 0.1 = 1.25 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.11 × 0.63 × 0.1 = 1.25 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.11 × 0.63 × 0.1 = 0.999 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.22 × 0.63 × 0.1 = 0.999 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.21 × 0.63 × 0.1 = 0.999 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.21 × 0.63 × 0.1 = 0.999 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.21 × 0.63 × 0.1 = 0.26.6 (FS)<br>Northeast 0.9x 0.77 × 3.15 × 0.21 × 0.63 × 0.1 = 0.26.6 (FS)<br>Northeast 0.9x 0.77 × 0.45 × 0.21 × 0.63 × 0.1 = 0.25.6 (FS)<br>Northeast 0.9x 0.77 × 0.45 × 0.21 × 0.63 × 0.1 = 0.25.6 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.21 × 0.63 × 0.1 = 0.25.6 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.21 × 0.63 × 0.1 = 0.25.6 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.21 × 0.63 × 0.1 = 0.25.6 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.21 × 0.63 × 0.1 = 0.25.6 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.22 (FS) 0.23 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.1 = 0.1 (FS)<br>Southwest0.9x 0.77 × 0.45 × 0.03 × 0.01 = 0.0 (FS)<br>Northeast0.9x 0.77 × 0.45 × 0.03 × 0.01 = 0.0 (FS)<br>Northeast0.9x 0.77   |   | _                     |           |        |          |           |          |          |        |           | _              |       |   | _        | _          |       |          |      |       |      |
|--|---|-----------------------|-----------|--------|----------|-----------|----------|----------|--------|-----------|----------------|-------|---|----------|------------|-------|----------|------|-------|------|
| Northeast 0.5x 0.77 x 3.15 x 4.138 x 0.63 x 0.1 = 5.66 (7)<br>Northeast 0.5x 0.77 x 3.15 x 67.98 x 0.63 x 0.1 = 12.26 (7)<br>Northeast 0.5x 0.77 x 3.15 x 91.35 x 0.63 x 0.1 = 12.26 (7)<br>Northeast 0.5x 0.77 x 3.15 x 91.1 x 0.63 x 0.1 = 12.26 (7)<br>Northeast 0.5x 0.77 x 3.15 x 91.1 x 0.63 x 0.1 = 12.26 (7)<br>Northeast 0.5x 0.77 x 3.15 x 91.1 x 0.63 x 0.1 = 12.23 (7)<br>Northeast 0.5x 0.77 x 3.15 x 14.2 x 0.63 x 0.1 = 6.33 (7)<br>Northeast 0.5x 0.77 x 3.15 x 14.2 x 0.63 x 0.1 = 6.33 (7)<br>Northeast 0.5x 0.77 x 3.15 x 14.2 x 0.63 x 0.1 = 6.43 (7)<br>Northeast 0.5x 0.77 x 3.15 x 14.2 x 0.63 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 1.27 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.53 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.67 x 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.57 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.57 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.57 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.57 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.57 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.57 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.55 5.50 0.63 x 0.1 = 0.53 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.53 5.50 0.452 0.21 2.01 0.40 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.53 5.50 0.452 0.21 2.01 0.1 0.20 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.53 5.50 0.452 0.21 2.01 0.1 0.20 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.53 5.50 0.452 0.21 2.01 0.1 0.20 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.53 5.50 0.452 0.21 2.01 0.1 0.20 (7)<br>Southwest 0.5x 0.77 x 0.45 x 0.50 0.50 0.50 0.51 0.50 0.50 0.50 0.50   | Northea   | st 0.9x               | 0.77      |        | x        | 3.1       | 5        | x        | 1      | 1.28      | ×              |       | 0.63  | <b>`</b> | Ľ          | 0.1   |          | =    | 1.55  | (75) |
| Notheast 0.9% 0.77 × 3.15 × 0.766 × 0.63 × 0.1 = 0.25 (75)<br>Notheast 0.9% 0.77 × 3.15 × 0.738 × 0.63 × 0.1 = 1.256 (75)<br>Notheast 0.9% 0.77 × 3.15 × 0.738 × 0.63 × 0.1 = 1.253 (78)<br>Notheast 0.9% 0.77 × 3.15 × 0.263 × 0.63 × 0.1 = 1.253 (78)<br>Notheast 0.9% 0.77 × 3.15 × 0.263 × 0.63 × 0.1 = 0.99 (76)<br>Notheast 0.9% 0.77 × 3.15 × 0.263 × 0.63 × 0.1 = 0.99 (76)<br>Notheast 0.9% 0.77 × 3.15 × 0.224 × 0.63 × 0.1 = 0.99 (76)<br>Notheast 0.9% 0.77 × 3.15 × 0.21 × 0.63 × 0.1 = 0.99 (76)<br>Notheast 0.9% 0.77 × 3.15 × 0.21 × 0.63 × 0.1 = 1.97 (75)<br>Southwest0.9% 0.77 × 0.46 × 0.627 0.63 × 0.1 = 1.27 (75)<br>Southwest0.9% 0.77 × 0.46 × 0.627 0.63 × 0.1 = 1.27 (75)<br>Southwest0.9% 0.77 × 0.46 × 0.627 0.63 × 0.1 = 0.58 (79)<br>Notheast 0.9% 0.77 × 0.46 × 0.627 0.63 × 0.1 = 0.58 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.58 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.58 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.53 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.26 0.63 × 0.1 = 0.50 (79)<br>Southwest0.9% 0.77 × 0.45 × 106.30 × 0.1 = 0.50 (79)<br>Southwest0.9% 0.77 × 0.45 × 0.53 5.307.5 307.6 30.7 1 = 0.50 (79)<br>Southwest0.9% 0.77 × 0.45 × 0.50 5.3 0.7 1 = 0.50 (79)<br>Southwest0.9% 0.77 × 0.45 × 0.50 5.3 0.7 1 = 0.50 (79)<br>Southwest0.9% 0.77 × 0.45 × 0.50 5.3 0.7 1 = 0.50 (79)<br>Mean internal temperature (heating pacta from Table 9, Th1 (°C) 21 (65)<br>Utilisation factor for gains for two drelling from Table 9, Th1 (°C)<br>Utilisation factor for gains for text of dwelling from Table 9, Th2 (°C)   | Northea   | st <u>0.9</u> x       | 0.77      |        | x        | 3.1       | 5        | x        | 2      | 2.97      | ×              |       | 0.63  | >        |            | 0.1   |          | =    | 3.16  | (75) |
| Northeast 0.4% 0.77 × $3.15$ × $97.38$ × $0.63$ × $0.1$ = $12.66$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $97.38$ × $0.63$ × $0.1$ = $12.26$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $97.38$ × $0.63$ × $0.1$ = $12.26$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $11.1$ × $0.63$ × $0.1$ = $9.99$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $12.2$ × $0.63$ × $0.1$ = $0.99$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $14.2$ × $0.63$ × $0.1$ = $1.25$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $14.2$ × $0.63$ × $0.1$ = $1.25$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $14.2$ × $0.63$ × $0.1$ = $1.25$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $14.2$ × $0.63$ × $0.1$ = $1.25$ (%)<br>Northeast 0.2% 0.77 × $3.15$ × $14.2$ × $0.63$ × $0.1$ = $1.25$ (%)<br>Northeast 0.2% 0.77 × $9.45$ × $82.77$ 0.63 × $0.1$ = $1.25$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $14.2$ × $0.63$ × $0.1$ = $1.25$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $102.25$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.1$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.1$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.1$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.1$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.1$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.1$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.1$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.15$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.15$ 0.63 × $0.1$ = $43.84$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $110.15$ 0.63 × $0.1$ = $25.86$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $104.28$ 0.63 × $0.1$ = $25.86$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $104.28$ 0.64 0.4 1 (%)<br>Southwest0.2% 0.77 × $9.45$ × $104.28$ 0.64 0.4 1 ( $2.44$ 0.27 ( $3.84.54$ (%)<br>Southwest0.2% 0.77 × $9.45$ × $104.48$ ( $3.93.64$ ( $3.95$ 0.76 No Dec<br>(%)<br>Mean internal temperature (heating searcent)<br>Temperature during heating periods in the living area from Table 9, Th (°C)<br>Utilisation factor for gains for text of dwelling from Table 9, Th 2 (°C)<br>(%) Mean i  | Northea   | st 0.9x               | 0.77      |        | x        | 3.1       | 5        | x        | 4      | 1.38      | x              |       | 0.63  | <b>)</b> |            | 0.1   |          | =    | 5.69  | (75) |
| Northeast 0.9x 0.77 × $8.15$ × $97.38$ × $0.63$ × $0.1$ = $13.39$ (rs)<br>Northeast 0.9x 0.77 × $3.15$ × $97.38$ × $0.63$ × $0.1$ = $12.53$ (rs)<br>Northeast 0.9x 0.77 × $3.15$ × $72.63$ × $0.63$ × $0.1$ = $12.53$ (rs)<br>Northeast 0.9x 0.77 × $3.15$ × $50.42$ × $0.63$ × $0.1$ = $6.99$ (r5)<br>Northeast 0.9x 0.77 × $3.15$ × $82.07$ × $0.63$ × $0.1$ = $6.99$ (r5)<br>Northeast 0.9x 0.77 × $3.15$ × $28.07$ × $0.63$ × $0.1$ = $6.99$ (r5)<br>Northeast 0.9x 0.77 × $3.15$ × $28.07$ × $0.63$ × $0.1$ = $1.85$ (r9)<br>Northeast 0.9x 0.77 × $3.15$ × $82.07$ × $0.63$ × $0.1$ = $1.85$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $85.79$ 0.63 × $0.1$ = $1.27$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $85.75$ 0.63 × $0.1$ = $25.86$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $85.75$ 0.63 × $0.1$ = $42.84$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $119.01$ 0.63 × $0.1$ = $43.84$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $119.01$ 0.63 × $0.1$ = $43.84$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $119.01$ 0.63 × $0.1$ = $43.84$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $119.01$ 0.63 × $0.1$ = $43.84$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $119.01$ 0.63 × $0.1$ = $44.7$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $119.01$ 0.63 × $0.1$ = $43.84$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $119.01$ 0.63 × $0.1$ = $44.7$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $104.39$ 0.63 × $0.1$ = $42.65$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $104.39$ 0.63 × $0.1$ = $42.65$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $64.57$ 0.63 × $0.1$ = $42.65$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $64.57$ 0.63 × $0.1$ = $12.99$ (r9)<br>Southwesto.9x 0.77 × $8.45$ × $104.39$ 0.63 × 0.1 = 12.99 (r9)<br>Southwesto.9x 0.77 × $8.45$ × $104.39$ 0.63 × 0.1 = 12.99 (r9)<br>Southwesto.9x 0.77 × $8.45$ × $64.57$ 0.43 × $104.39$ 0.63 × 0.1 = 12.99 (r9)<br>Southwesto.9x 0.77 × $8.45$ × $104.39$ 0.63 × 0.1 = 12.99 (r9)<br>Southwesto.9x 0.77 × $8.45$ × $104.39$ 0.63 × 0.1 = 12.99 (r9)<br>Southwesto.9x 0.97 0.70 × $8.45$ × $104.39$ 0.90 0.80 0.55 0.99 (r8)<br>Mean internal emperature (heat prometion in the ing area from Table 9.1 Th (°C)<br>(if)ma 0.99 0.98 0.95 0.86 0.7 0.92 0.9   | Northea   | st 0.9x               | 0.77      |        | x        | 3.1       | 5        | x        | 6      | 7.96      | ×              |       | 0.63  | <b>)</b> |            | 0.1   |          | =    | 9.35  | (75) |
| Northeast 0.5 0.77 x 0.15 x 0.1 x 0.63 x 0.1 = 0.253 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.64 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.15 x 0.63 x 0.1 = 0.99 (75)<br>Northeast 0.5 0.77 x 0.45 x 0.63 x 0.1 = 0.127 (75)<br>Southwest0.5 0.77 x 0.45 x 0.57 0.63 x 0.1 = 0.25.66 (79)<br>Southwest0.5 0.77 x 0.45 x 0.957 0.63 x 0.1 = 0.43.84 (79)<br>Southwest0.5 0.77 x 0.45 x 0.957 0.63 x 0.1 = 0.43.84 (79)<br>Southwest0.5 0.77 x 0.45 x 0.957 0.63 x 0.1 = 0.43.84 (79)<br>Southwest0.5 0.77 x 0.45 x 0.957 0.63 x 0.1 = 0.43.84 (79)<br>Southwest0.5 0.77 x 0.45 x 0.957 0.63 x 0.1 = 0.43.84 (79)<br>Southwest0.5 0.77 x 0.45 x 0.113.91 0.63 x 0.1 = 0.43.84 (79)<br>Southwest0.5 0.77 x 0.45 x 0.113.91 0.63 x 0.1 = 0.43.84 (79)<br>Southwest0.5 0.77 x 0.45 x 0.113.91 0.63 x 0.1 = 0.43.77 (79)<br>Southwest0.5 0.77 x 0.45 x 0.13.91 0.63 x 0.1 = 0.43.77 (79)<br>Southwest0.5 0.77 x 0.45 x 0.13.91 0.63 x 0.1 = 0.43.77 (79)<br>Southwest0.5 0.77 x 0.45 x 0.13.91 0.63 x 0.1 = 0.43.97 (79)<br>Southwest0.5 0.77 x 0.45 x 0.13.91 0.63 x 0.1 = 0.43.97 (79)<br>Southwest0.5 0.77 x 0.45 x 0.13.91 0.63 x 0.1 = 0.43.97 (79)<br>Southwest0.5 0.77 x 0.45 x 0.14 0.12 0.63 x 0.1 = 0.43.97 (79)<br>Southwest0.5 0.77 x 0.45 x 0.14 0.12 0.63 x 0.1 = 0.43.97 (79)<br>Southwest0.5 0.77 x 0.45 x 0.14 0.15 0.10 0.1 = 0.299 (79)<br>Southwest0.5 0.77 x 0.45 x 0.14 0.15 0.10 0.1 = 0.299 (79)<br>Southwest0.5 0.77 x 0.45 x 0.44 0.75 0.44 0.75 0.45 0.63 x 0.1 = 0.43.97 (79)<br>Southwest0.5 0.77 x 0.45 0.5 0.70 0.5 0.36 0.37 0.56 0.81 0.96 0.99<br>(8)<br>Mean internal temperature (heating season)<br>Temperature during heating periods in rest of dwelling from Table 90)<br>(7)m 0.20.4 0.20.5 0.20.8 0.36 0.7 0.5 0.36 0.37 0.56 0.81 0.96 0.99<br>(8)<br>Mean internal temperature in living area 11 (follow steps 3 t  | Northea   | st <u>0.9</u> x       | 0.77      |        | x        | 3.1       | 5        | x        | 9      | 1.35      | x              |       | 0.63  | >        | : [        | 0.1   |          | =    | 12.56 | (75) |
| Northeast 0.5x 0.77 × 0.15 × 0.22 × 0.63 × 0.1 = 0.99 (75)<br>Northeast 0.5x 0.77 × 0.15 × 0.62 × 0.63 × 0.1 = 0.99 (75)<br>Northeast 0.5x 0.77 × 0.15 × 0.62 × 0.63 × 0.1 = 0.99 (75)<br>Northeast 0.5x 0.77 × 0.15 × 0.62 × 0.63 × 0.1 = 0.95 (75)<br>Northeast 0.5x 0.77 × 0.15 × 0.21 × 0.63 × 0.1 = 0.95 (75)<br>Southwest 0.5x 0.77 × 0.45 × 0.27 · 0.63 × 0.1 = 0.15 (16) (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.627 • 0.63 × 0.1 = 0.518 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.627 • 0.63 × 0.1 = 0.518 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.627 • 0.63 × 0.1 = 0.538 (79)<br>Southwest 0.5x 0.77 × 0.45 × 106.25 • 0.63 × 0.1 = 0.538 (79)<br>Southwest 0.5x 0.77 × 0.45 × 106.25 • 0.63 × 0.1 = 0.538 (79)<br>Southwest 0.5x 0.77 × 0.45 × 100.10 • 0.63 × 0.1 = 0.538 (79)<br>Southwest 0.5x 0.77 × 0.45 × 100.10 • 0.63 × 0.1 = 0.538 (79)<br>Southwest 0.5x 0.77 × 0.45 × 118.10 • 0.63 × 0.1 = 0.438 (79)<br>Southwest 0.5x 0.77 × 0.45 × 118.10 • 0.63 × 0.1 = 0.438 (79)<br>Southwest 0.5x 0.77 × 0.45 × 118.10 • 0.63 × 0.1 = 0.437 (79)<br>Southwest 0.5x 0.77 × 0.45 × 118.10 • 0.63 × 0.1 = 0.477 (79)<br>Southwest 0.5x 0.77 × 0.45 × 104.39 • 0.63 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.63 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.63 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.63 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.63 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.65 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.65 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.65 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.65 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.65 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.65 × 0.1 = 0.487 (79)<br>Southwest 0.5x 0.77 × 0.45 × 0.4407 • 0.65 × 0.1 = 0.618 (79)<br>Temperature during heating periods in the living area from Table 9, Th1 (*C) 1 = 0.482 (64)<br>(6)m 0.59 0.98 0.95 0.96 0.7 0.5 0.56 0.37 0.56 0.81 0.95 0.99<br>Mean internal temperature (heating season)<br>Mean internal temperature in livi  | Northea   | st <u>0.9</u> x       | 0.77      |        | x        | 3.1       | 5        | x        | 9      | 7.38      | x              |       | 0.63  | >        | : [        | 0.1   |          | =    | 13.39 | (75) |
| Northeast 0.32 0.77 × 3.15 × 50.42 × 0.63 × 0.1 = 6.83 (75)<br>Northeast 0.52 0.77 × 3.15 × 28.07 × 0.63 × 0.1 = 1.95 (75)<br>Northeast 0.52 0.77 × 3.15 × 9.21 × 0.63 × 0.1 = 1.27 (75)<br>Northeast 0.52 0.77 × 9.45 × 35.79 0.63 × 0.1 = 1.27 (75)<br>Southwest 0.52 0.77 × 9.45 × 35.79 0.63 × 0.1 = 25.86 (79)<br>Southwest 0.52 0.77 × 9.45 × 35.79 0.63 × 0.1 = 25.86 (79)<br>Southwest 0.52 0.77 × 9.45 × 106.25 0.63 × 0.1 = 43.84 (79)<br>Southwest 0.52 0.77 × 9.45 × 106.25 0.63 × 0.1 = 43.84 (79)<br>Southwest 0.52 0.77 × 9.45 × 106.25 0.63 × 0.1 = 43.84 (79)<br>Southwest 0.52 0.77 × 9.45 × 118.01 0.63 × 0.1 = 43.81 (79)<br>Southwest 0.52 0.77 × 9.45 × 118.01 0.63 × 0.1 = 43.81 (79)<br>Southwest 0.52 0.77 × 9.45 × 118.01 0.63 × 0.1 = 43.81 (79)<br>Southwest 0.52 0.77 × 9.45 × 118.01 0.63 × 0.1 = 43.81 (79)<br>Southwest 0.52 0.77 × 9.45 × 118.01 0.63 × 0.1 = 43.81 (79)<br>Southwest 0.52 0.77 × 9.45 × 118.01 0.63 × 0.1 = 43.87 (79)<br>Southwest 0.52 0.77 × 9.45 × 113.91 0.63 × 0.1 = 43.07 (79)<br>Southwest 0.52 0.77 × 9.45 × 104.39 0.63 × 0.1 = 43.07 (79)<br>Southwest 0.52 0.77 × 9.45 × 104.39 0.63 × 0.1 = 43.07 (79)<br>Southwest 0.52 0.77 × 9.45 × 40.439 0.63 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 9.45 × 40.429 0.63 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 9.45 × 49.45 × 104.39 0.63 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 9.45 × 49.45 × 31.49 0.65 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 9.45 × 49.45 × 31.49 0.65 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 9.45 × 49.45 × 31.49 0.65 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 9.45 × 49.45 × 31.49 0.65 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 0.53 0.56 0.51 0.52 0.53 × 0.1 = 28.58 (79)<br>Southwest 0.52 0.77 × 0.53 0.56 0.51 0.52 0.50 0.50 0.51 0.50 0.51 0.50 0.50 0.50   | Northea   | st 0.9x               | 0.77      |        | x        | 3.1       | 5        | x        | 9      | 91.1      | ×              |       | 0.63  | _        | Ē          | 0.1   |          | =    | 12.53 | (75) |
| Northeast 0.5. 0.77 × 0.15 × 0.63 × 0.1 = 0.86 (75)<br>Northeast 0.5. 0.77 × 0.15 × 0.42 × 0.63 × 0.1 = 1.95 (75)<br>Southwest 0.5. 0.77 × 0.45 × 0.679 0.63 × 0.1 = 0.27 (75)<br>Southwest 0.5. 0.77 × 0.45 × 0.679 0.63 × 0.1 = 0.518 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.627 0.63 × 0.1 = 0.55.86 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.625 0.63 × 0.1 = 0.55.86 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.625 0.63 × 0.1 = 0.43.84 (79)<br>Southwest 0.5. 0.77 × 0.45 × 106.25 0.63 × 0.1 = 0.43.84 (79)<br>Southwest 0.5. 0.77 × 0.45 × 106.25 0.63 × 0.1 = 0.43.84 (79)<br>Southwest 0.5. 0.77 × 0.45 × 106.25 0.63 × 0.1 = 0.43.77 (79)<br>Southwest 0.5. 0.77 × 0.45 × 104.39 0.63 × 0.1 = 0.47 (79)<br>Southwest 0.5. 0.77 × 0.45 × 104.39 0.63 × 0.1 = 0.43.17 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.43.9 0.63 × 0.1 = 0.43.17 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.43.9 0.63 × 0.1 = 0.43.7 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.63 × 0.1 = 0.43.7 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.63 × 0.1 = 0.43.7 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.63 × 0.1 = 0.43.7 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.63 × 0.1 = 0.43.7 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.63 × 0.1 = 0.43.7 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.63 × 0.1 = 0.43.8 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.68 × 0.1 = 0.43.8 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.68 × 0.1 = 0.44.9 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.68 × 0.1 = 0.43.8 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.68 × 0.1 = 0.44.9 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.68 × 0.1 = 0.44.9 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.44.9 0.68 × 0.1 = 0.44.9 (79)<br>Southwest 0.5. 0.77 × 0.45 × 0.10.9 (80)<br>Mean internal and solar (84)m = (73)m + (83)m , watts<br>(44)m - 44.2 451.67 448.23 438.65 424.41 403.5 387.7 392.18 402.27 415.8 428.98 (84)<br>Temperature during heating periods in the living area from Table 9, Th1 (°C)<br>Utilisation factor for gains for living area 11 (follow steps 3 to 7 in Table 9C)<br>(7)m - 2.04 2.087 2.038 2.0.88 2.1 2.1 2.1 2.1 2.1 2.0.99 2.038 2.0.83 (67)<br>Temperature during heatin  | Northea   | st <u>0.9</u> x       | 0.77      |        | x        | 3.1       | 5        | x        | 7      | 2.63      | Ī×             |       | 0.63  | _<br>_ , | Ē          | 0.1   |          | =    | 9.99  | (75) |
| Northeast 0.4 0 0.77 x 0.15 x 14.2 x 0.63 x 0.1 = 1.95 (7)<br>Northeast 0.5 0.77 x 0.15 x 0.21 x 0.63 x 0.1 = 1.27 (75)<br>Southwest 0.5 0.77 x 0.45 x 0.63 x 0.1 = 15.18 (79)<br>Southwest 0.5 0.77 x 0.45 x 0.625 0.63 x 0.1 = 25.86 (79)<br>Southwest 0.5 0.77 x 0.45 x 0.625 0.63 x 0.1 = 38.38 (79)<br>Southwest 0.5 0.77 x 0.45 x 106.25 0.63 x 0.1 = 43.84 (79)<br>Southwest 0.5 0.77 x 0.45 x 106.25 0.63 x 0.1 = 43.84 (79)<br>Southwest 0.5 0.77 x 0.45 x 106.25 0.63 x 0.1 = 447 (75)<br>Southwest 0.5 0.77 x 0.45 x 106.25 0.63 x 0.1 = 447 (75)<br>Southwest 0.5 0.77 x 0.45 x 113.91 0.63 x 0.1 = 447 (75)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 447 (75)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 43.07 (79)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 43.84 (79)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 447 (75)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 43.07 (79)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 447 (75)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 43.07 (79)<br>Southwest 0.5 0.77 x 0.45 x 104.39 0.63 x 0.1 = 12.99 (79)<br>Southwest 0.5 0.77 x 0.45 x 0.4407 0.68 x 0.1 = 12.99 (79)<br>Southwest 0.5 0.77 x 0.45 x 0.4407 0.68 x 0.1 = 12.99 (79)<br>Southwest 0.5 0.77 x 0.45 x 0.4407 0.68 x 0.1 = 12.99 (78)<br>Southwest 0.5 0.77 x 0.45 x 0.31 0.40 (83) m watts<br>(84)m 442.3 451.67 442.3 438.65 424.41 403.5 387.5 387.78 32.18 402.27 415.8 428.98 (84)<br><b>7. Mean internal temperature</b> (heating season)<br>Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)<br>Utilisation factor for gains for living area, 11, m (see Table 9a)<br>(60)m 0.99 0.98 0.35 0.86 0.7 0.5 0.38 0.37 0.56 0.81 0.35 0.98 (86)<br>Mean internal temperature in living area 11 (follow steps 3 to 7 in Table 9C)<br>(77m 20.4 2.87 7.03 2.0.98 21 21 21 21 21 2.0.99 20.83 20.83 (87)<br>Temperature during heating periods in rest of dwelling from Table 9.<br>(67)m 20.4 2.87 7.03 2.0.98 20.6 20.6 20.6 120.61 20.61 20.6 20.6 20.6 (89)<br>Utilisation factor for gains for rest of dwelling, h2, m (see Table 9a)<br>(99m 0.88 0.97 0.94 0.84 0   | Northea   | st <u>0.9</u> x       | 0.77      |        | x        | 3.1       | 5        | x        | 5      | 0.42      | x              |       | 0.63  | _ ,      | Ē          | 0.1   |          | =    | 6.93  | (75) |
| Northeast $0.9k$ $0.77$ x $3.15$ x $9.21$ x $0.63$ x $0.1$ = $1.27$ (rs)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $62.67$ $0.63$ x $0.1$ = $15.18$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $62.67$ $0.63$ x $0.1$ = $25.86$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $85.75$ $0.63$ x $0.1$ = $43.64$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $106.25$ $0.63$ x $0.1$ = $43.64$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $106.25$ $0.63$ x $0.1$ = $43.64$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $106.25$ $0.63$ x $0.1$ = $43.75$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $106.25$ $0.63$ x $0.1$ = $43.77$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $106.25$ $0.63$ x $0.1$ = $43.77$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $43.77$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $43.77$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $43.07$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $43.61$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $43.61$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $43.61$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $28.58$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $12.99$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $12.99$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $12.99$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.63$ x $0.1$ = $28.58$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $104.39$ $0.53$ $0.37$ $0.54$ $0.11$ = $12.99$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $0.1$ (r9)<br>Southwesto, $9k$ $0.77$ x $9.45$ x $0.1$ (r9)<br>(r9) $10.90$ $1$   | Northea   | st 0.9x               | 0.77      |        | x        | 3.1       | 5        | x        | 2      | 8.07      | Ī×             |       | 0.63  | _<br>_ , | Ē          | 0.1   |          | =    | 3.86  | (75) |
| Southwesto, 9, 0.77 x 9.45 x 0.67 0.63 x 0.1 = 15.18 (79)<br>Southwesto, 9, 0.77 x 9.45 x 0.62.67 0.63 x 0.1 = 25.86 (79)<br>Southwesto, 9, 0.77 x 9.45 x 106.25 0.63 x 0.1 = 43.84 (79)<br>Southwesto, 9, 0.77 x 9.45 x 106.25 0.63 x 0.1 = 43.84 (79)<br>Southwesto, 9, 0.77 x 9.45 x 119.01 0.63 x 0.1 = 49.1 (79)<br>Southwesto, 9, 0.77 x 9.45 x 119.01 0.63 x 0.1 = 44.77 (79)<br>Southwesto, 9, 0.77 x 9.45 x 113.91 0.63 x 0.1 = 44.77 (79)<br>Southwesto, 9, 0.77 x 9.45 x 113.91 0.63 x 0.1 = 44.77 (79)<br>Southwesto, 9, 0.77 x 9.45 x 113.91 0.63 x 0.1 = 44.77 (79)<br>Southwesto, 9, 0.77 x 9.45 x 113.91 0.63 x 0.1 = 44.07 (79)<br>Southwesto, 9, 0.77 x 9.45 x 113.91 0.63 x 0.1 = 44.07 (79)<br>Southwesto, 9, 0.77 x 9.45 x 113.91 0.63 x 0.1 = 48.07 (79)<br>Southwesto, 9, 0.77 x 9.45 x 14.39 0.63 x 0.1 = 48.07 (79)<br>Southwesto, 9, 0.77 x 9.45 x 44.07 0.63 x 0.1 = 48.07 (79)<br>Southwesto, 9, 0.77 x 9.45 x 44.07 0.63 x 0.1 = 48.07 (79)<br>Southwesto, 9, 0.77 x 9.45 x 44.07 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 44.07 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.63 x 0.1 = 128.58 (79)<br>Southwesto, 9, 0.77 x 9.45 x 31.49 0.5 3.0.76 3.0.76 3.0.1 4.020 (100.000000000000000000000000000000000   | Northea   | st <u>0.9</u> x       | 0.77      |        | x        | 3.1       | 5        | x        | · ·    | 14.2      | Ī×             |       | 0.63  | ,        | Ē          | 0.1   |          | =    | 1.95  | (75) |
| Southwesto 9: 0.77 × 9.45 × 62.67 0.63 × 0.1 = 25.86 (9)<br>Southwesto 9: 0.77 × 9.45 × 106.25 0.63 × 0.1 = 43.84 (79)<br>Southwesto 9: 0.77 × 9.45 × 119.01 0.63 × 0.1 = 49.1 (79)<br>Southwesto 9: 0.77 × 9.45 × 119.01 0.63 × 0.1 = 443.75 (79)<br>Southwesto 9: 0.77 × 9.45 × 119.01 0.63 × 0.1 = 443.75 (79)<br>Southwesto 9: 0.77 × 9.45 × 104.39 0.63 × 0.1 = 443.75 (79)<br>Southwesto 9: 0.77 × 9.45 × 104.39 0.63 × 0.1 = 43.81 (79)<br>Southwesto 9: 0.77 × 9.45 × 104.39 0.63 × 0.1 = 43.71 (79)<br>Southwesto 9: 0.77 × 9.45 × 104.39 0.63 × 0.1 = 43.81 (79)<br>Southwesto 9: 0.77 × 9.45 × 9.45 × 0.43.9 0.63 × 0.1 = 43.81 (79)<br>Southwesto 9: 0.77 × 9.45 × 9.45 × 0.43.9 0.63 × 0.1 = 18.18 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.95 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9: 0.80 0.32 0.50 0.50 0.51 0.95 0.99 (86)<br>Mean internal temperature (heating seeson)<br>Temperature during heating periods in the living area from Table 9. Th1 (°C)<br>(80)m 20.59 0.59 0.59 0.59 0.50 2.06 0.6 0.61 0.61 0.61 0.5 0.59 0.50 0.59 (86)<br>Utilisation factor for gains for rest of dwelling f  | Northea   | st <u>0.9</u> x       | 0.77      |        | x        | 3.1       | 5        | x        |        | 9.21      | ] ×            |       | 0.63  | ,        | Ē          | 0.1   |          | =    | 1.27  | (75) |
| Southwest0.9x $0.77$ x       9.45       x       85.75 $0.63$ x $0.1$ =       35.38       (79)         Southwest0.9x $0.77$ x       9.45       x       106.25 $0.63$ x $0.1$ =       43.84       (79)         Southwest0.9x $0.77$ x       9.45       x       119.01 $0.63$ x $0.1$ =       43.84       (79)         Southwest0.9x $0.77$ x       9.45       x       113.91 $0.63$ x $0.1$ =       44.75       (79)         Southwest0.9x $0.77$ x       9.45       x       104.39 $0.63$ x $0.1$ =       43.07       (79)         Southwest0.9x $0.77$ x       9.45       x       104.39 $0.63$ x $0.1$ =       30.7       9.95       x $69.27$ $0.83$ x $0.1$ =       38.56       (79)       Southwest0.9x $0.77$ x       9.45       x $31.49$ $0.63$ x $0.1$ = $31.81$ (79)       Southwest0.9x $0.77$   | Southwe   | est <mark>0.9x</mark> | 0.77      |        | x        | 9.4       | 5        | x        | 3      | 6.79      | ī              |       | 0.63  | Ξ,       | Ē          | 0.1   |          | =    | 15.18 | (79) |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$   | Southwe   | est <mark>0.9x</mark> | 0.77      |        | x        | 9.4       | 5        | x        | 6      | 2.67      | i              |       | 0.63  | Ξ,       | Ē          | 0.1   |          | =    | 25.86 | (79) |
| Southwest0.9x $0.77$ $x$ 9.45 $x$ 119.01 $0.63$ $x$ $0.1$ $=$ 49.1       (79)         Southwest0.9x $0.77$ $x$ 9.45 $x$ 118.15 $0.63$ $x$ $0.1$ $=$ 48.75       (79)         Southwest0.9x $0.77$ $x$ 9.45 $x$ 104.39 $0.63$ $x$ $0.1$ $=$ 43.07       (79)         Southwest0.9x $0.77$ $x$ 9.45 $x$ 104.39 $0.63$ $x$ $0.1$ $=$ 43.07       (79)         Southwest0.9x $0.77$ $x$ 9.45 $x$ $69.27$ $0.63$ $x$ $0.1$ $=$ $48.17$ (79)         Southwest0.9x $0.77$ $x$ $9.45$ $x$ $44.07$ $0.63$ $x$ $0.1$ $=$ $48.3.07$ (79)         Southwest0.9x $0.77$ $x$ $9.45$ $x$ $44.07$ $0.63$ $x$ $0.1$ $=$ $48.3.07$ (79) $x$ $0.45$ $0.63$ $x$ $0.1$ $=$   | Southwe   | est <mark>0.9x</mark> | 0.77      |        | x        | 9.4       | 5        | x        | 8      | 5.75      | í              |       | 0.63  | Ξ,       | Ē          | 0.1   |          | =    | 35.38 | (79) |
| Southwesto $\frac{1}{3}$ $1$ | Southwe   | est <mark>0.9x</mark> | 0.77      |        | x        | 9.4       | 5        | x        | 10     | 06.25     | i              |       | 0.63  | Ϊ,       | Ē          | 0.1   |          | =    | 43.84 | (79) |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$  | Southwe   | est <mark>0.9x</mark> | 0.77      |        | x        | 9.4       | 5        | x        | 1      | 19.01     | i              |       | 0.63  | ۲,       | Ē          | 0.1   |          | =    | 49.1  | (79) |
| Southwesto 9, 0.77 × 9.45 × 104.39 0.63 × 0.1 = 43.07 (79)<br>Southwesto 9, 0.77 × 9.45 × 0.285 0.683 × 0.1 = 38.31 (79)<br>Southwesto 9, 0.77 × 9.45 × 0.827 0.63 × 0.1 = 28.58 (79)<br>Southwesto 9, 0.77 × 9.45 × 0.4407 0.63 × 0.1 = 18.18 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.63 × 0.1 = 12.99 (79)<br>Southwesto 9, 0.77 × 9.45 × 31.49 0.68 (83)<br>Total gains – internal and solar (84)m = (73)m + (83)m , watts<br>(84)m = 442.3 451.67 449.23 438.65 424.41 403.5 387.5 387.78 392.18 402.27 415.8 428.98 (84)<br><b>7. Mean internal temperature (heating season)</b><br>Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)<br>Utilisation factor for gains for living area, h1,m (see Table 9a)<br>(86)m = 0.99 0.98 0.95 0.86 0.7 0.5 0.36 0.37 0.56 0.81 0.95 0.99 (86)<br>Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)<br>(87)m = 20.84 20.87 20.93 20.98 21 21 21 21 21 20.99 20.93 20.83 (87)<br>Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)<br>(89)m = 20.59 20.59 20.59 20.6 20.6 20.6 120.61 20.61 20.6 20.6 20.6 (88)<br>Utilisation factor for gains for rest of dwelling from Table 9, Th2 (°C)<br>(89)m = 0.98 0.97 0.94 0.84 0.67 0.47 0.32 0.34 0.53 0.79 0.94 0.99 (89)  | Southwe   | est0.9x               | 0.77      |        | x        | 9.4       | 5        | X        | 1      | 18.15     | 1              |       | 0.63  | >        |            | 0.1   |          | =    | 48.75 | (79) |
| Southwesto 9x 0.77 x 9.45 92.85 0.63 x 0.1 = 38.31 (79)<br>Southwesto 9x 0.77 x 9.45 x 69.27 0.63 x 0.1 = 28.58 (79)<br>Southwesto 9x 0.77 x 9.45 x 44.07 0.63 x 0.1 = 28.58 (79)<br>Southwesto 9x 0.77 x 9.45 x 44.07 0.63 x 0.1 = 18.18 (79)<br>Southwesto 9x 0.77 x 9.45 x 31.49 0.63 x 0.1 = 12.99 (79)<br>Southwesto 9x 0.77 x 9.45 x 31.49 0.63 x 0.1 = 12.99 (79)<br>Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m<br>(83)m = 16.73 29.02 41.07 53.18 61.66 62.14 59.53 53.06 45.24 32.44 20.13 14.26 (83)<br>Total gains - internal and solar (84)m = (73)m + (83)m , watts<br>(84)m = 442.3 451.67 449.23 438.65 424.41 403.5 387.5 387.78 392.18 402.27 415.8 428.98 (64)<br><b>7. Mean internal temperature (heating season)</b><br>Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)<br>Utilisation factor for gains for living area, h1,m (see Table 9a)<br>Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)<br>(87)m = 20.84 20.87 20.93 20.98 21 21 21 21 21 21 20.99 20.93 20.83 (87)<br>Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)<br>(89)m = 20.59 20.59 20.6 20.6 20.6 20.61 20.61 20.61 20.6 20.6 20.6 (88)<br>Utilisation factor for gains for rest of dwelling from Table 9, Th2 (°C)<br>(89)m = 0.98 0.97 0.94 0.84 0.67 0.47 0.32 0.34 0.53 0.79 0.94 0.99 (89)   | Southwest <sub>0.9x</sub> 0.77 x 9.45 x 113.91 0.63 x 0.1 = 47    |                       |           |        |          |           |          |          |        |           |                |       |   |          | (79)       |       |          |      |       |      |
| Southwesto.3x       0.77       x       9.45       x       69.27       0.63       x       0.1       =       28.58       (79)         Southwesto.3x       0.77       x       9.45       x       44.07       0.63       x       0.1       =       18.18       (79)         Southwesto.3x       0.77       x       9.45       x       31.49       0.63       x       0.1       =       18.18       (79)         Southwesto.3x       0.77       x       9.45       x       31.49       0.63       x       0.1       =       18.18       (79)         Southwesto.3x       0.77       x       9.45       x       31.49       0.63       x       0.1       =       18.18       (79)         Southwesto.3x       0.77       x       9.45       x       31.49       0.63       x       0.1       =       18.18       (79)         Southwesto.3x       0.77       x       9.45       x       31.49       0.63       x       0.1       =       28.58       (64)         Southwesto.3x       calculated for each month       (83)m = Sum(74)m(82)m       (82)m       (84)m       (84)m       (84)m       (84)m <td< td=""><td colspan="15">Southwest<sub>0.9x</sub> 0.77 x 9.45 x 104.39 0.63 x 0.1 = 43.07</td><td>(79)</td></td<>   | Southwest <sub>0.9x</sub> 0.77 x 9.45 x 104.39 0.63 x 0.1 = 43.07 |                       |           |        |          |           |          |          |        |           |                |       |   |          |            | (79)  |          |      |       |      |
| Southwesto.9x $0.77$ x $9.45$ x $69.27$ $0.63$ x $0.1$ = $28.58$ $(79)$ Southwesto.9x $0.77$ x $9.45$ x $44.07$ $0.63$ x $0.1$ = $18.18$ $(79)$ Southwesto.9x $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $12.99$ $(79)$ Southwesto.9x $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $12.99$ $(79)$ Southwesto.9x $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $12.99$ $(79)$ Southwesto.9x $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $12.99$ $(79)$ Southwesto.9x $0.77$ x $9.45$ $x$ $31.49$ $0.63$ $x$ $0.1$ $=$ $12.99$ $(79)$ $(79)$ $(79)$ $(79)$ $(79)$ $(79)$ $(79)$ <t< td=""><td colspan="14"></td><td>(79)</td></t<>   |   |                       |           |        |          |           |          |          |        |           |                |       |   |          | (79)       |       |          |      |       |      |
| Southwesto.gx $0.77$ x $9.45$ $44.07$ $0.63$ x $0.1$ = $18.18$ $(79)$ Southwesto.gx $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $18.18$ $(79)$ Southwesto.gx $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $18.18$ $(79)$ Southwesto.gx $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $18.18$ $(79)$ Southwesto.gx $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $18.18$ $(79)$ Southwesto.gx $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $12.99$ $(79)$ Southwesto.gx $0.22$ $41.07$ $53.18$ $61.66$ $62.14$ $59.53$ $53.06$ $45.24$ $32.44$ $20.13$ $14.26$ $(83)$ Temperature during heating periods in the living area from Table 9, Th1 (°C)   |   |                       |           |        |          |           |          |          |        |           |                |       |   |          |            | (79)  |          |      |       |      |
| Southwest0.9x $0.77$ x $9.45$ x $31.49$ $0.63$ x $0.1$ = $12.99$ $(79)$ Solar gains in watts, calculated for each month       (83)m = Sum(74)m(82)m       (83)         (83)m = $16.73$ $29.02$ $41.07$ $53.18$ $61.66$ $62.14$ $59.53$ $53.06$ $45.24$ $32.44$ $20.13$ $14.26$ (83)         Total gains - internal and solar (84)m = (73)m + (83)m, watts       (84)m = $442.3$ $451.67$ $449.23$ $438.65$ $424.41$ $403.5$ $387.5$ $387.78$ $392.18$ $402.27$ $415.8$ $428.98$ (84) <b>Temperature during heating periods in the living area from Table 9, Th1 (°C)</b> $21$ (85)         Utilisation factor for gains for living area, h1,m (see Table 9a)         (86)m = $0.99$ $0.98$ $0.35$ $0.36$ $0.37$ $0.56$ $0.81$ $0.95$ $0.99$ (86)         Mar Apr May Jun Jul Aug Sep Oct Nov Dec $0.97$ $0.98$ $0.37$ $0.56$ $0.81$ $0.95$ $0.99$ (86)         Mar Apr May Jun Jul Aug Sep Oc  | Southwe   | est <mark>0.9x</mark> |           |        | x        |           | =        | x        |        | _         | i –            |       | 0.63  | Ξ,       | Ē          | 0.1   |          | =    | 18.18 | (79) |
| Solar gains in watts, calculated for each month       (83)m = Sum(74)m(82)m         (63)m = 16.73       29.02       41.07       53.18       61.66       62.14       59.53       53.06       45.24       32.44       20.13       14.26       (83)         Total gains - internal and solar (84)m = (73)m + (83)m, watts       (84)m = $442.3$ 451.67       449.23       438.65       424.41       403.5       387.75       392.18       402.27       415.8       428.98       (84) <b>Cheating season Temperature during heating periods in the living area from Table 9, Th1 (°C)</b> 21       (85)         Utilisation factor for gains for living area, h1,m (see Table 9a)         (86)m =       0.98       0.95       0.86       0.7       0.5       0.36       0.37       0.56       0.81       0.95       0.99       (86)         Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)       (87)m =       20.84       20.87       20.93       20.82       21       21       21       21.99       20.93       20.83       (87)         Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)       (88)m =       20.59       20.59       20.6       20.6       20.61       20.61 <td>Southwe</td> <td>est<sub>0.9x</sub></td> <td></td> <td></td> <td>x</td> <td></td> <td></td> <td>х</td> <td>-</td> <td></td> <td>i</td> <td></td> <td></td> <td></td> <td>Ē</td> <td></td> <td></td> <td>=</td> <td></td> <td>(79)</td>   | Southwe   | est <sub>0.9x</sub>   |           |        | x        |           |          | х        | -      |           | i              |       |   |          | Ē          |       |          | =    |       | (79) |
| (83)m=       16.73       29.02       41.07       53.18       61.66       62.14       59.53       53.06       45.24       32.44       20.13       14.26       (83)         Total gains - internal and solar (84)m = (73)m + (83)m , watts       (84)m=       442.3       451.67       449.23       438.65       424.41       403.5       387.5       387.78       392.18       402.27       415.8       428.98       (84) <b>Constant temperature (heating season Temperature during heating periods in the living area from Table 9, Th1 (°C)</b> 21       (85) <b>Utilisation factor for gains for living area, h1,m (see Table 9a) Mar</b> Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         (86)m=       0.99       0.98       0.95       0.86       0.7       0.5       0.36       0.37       0.56       0.81       0.95       0.89       (86) <b>Mar</b> Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         (86)m=       0.99       0.98       0.95       0.86       0.7       0.5       0.36       0.37       0.56  |   |                       |           |        |          |           |          |          |        |           | 1              | L     |   |          |            |       |          |      |       |      |
| (83)m=       16.73       29.02       41.07       53.18       61.66       62.14       59.53       53.06       45.24       32.44       20.13       14.26       (83)         Total gains - internal and solar (84)m = (73)m + (83)m , watts       (84)m=       442.3       451.67       449.23       438.65       424.41       403.5       387.5       387.78       392.18       402.27       415.8       428.98       (84) <b>Constant temperature (heating season Temperature during heating periods in the living area from Table 9, Th1 (°C)</b> 21       (85) <b>Utilisation factor for gains for living area, h1,m (see Table 9a) Mar</b> Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         (86)m=       0.99       0.98       0.95       0.86       0.7       0.5       0.36       0.37       0.56       0.81       0.95       0.89       (86) <b>Mar</b> Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         (86)m=       0.99       0.98       0.95       0.86       0.7       0.5       0.36       0.37       0.56  | Solar q   | ains in v             | watts, ca | alcula | ated     | for eacl  | n mont   | h        |        |           | (83)           | m = S | um(74)m .                                     | (82)     | m          |       |          |      |       |      |
| (84)m=       442.3       451.67       449.23       438.65       424.41       403.5       387.5       387.78       392.18       402.27       415.8       428.98       (84) <b>T. Mean internal temperature (heating season)</b> Temperature during heating periods in the living area from Table 9, Th1 (°C)       21       (85)         Utilisation factor for gains for living area, h1,m (see Table 9a) <b>Jan</b> Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec       (86)         (86)m=       0.99       0.98       0.95       0.86       0.7       0.5       0.36       0.37       0.56       0.81       0.95       0.99       (86)         Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)       (87)         (87)m=       20.84       20.87       20.98       21       21       21       21       20.99       20.93       20.83       (87)         Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)       (88)m=       20.59       20.59       20.6       20.6       20.61       20.61       20.6       20.6       (88)       (89)m=       (98)   | ſ   |                       |           | I      | 1        |           |          |          | 62.14  | 59.53     | 53             | 3.06  | 45.24   | 32.      | 44         | 20.13 | 14.      | .26  |       | (83) |
| Temperature during heating periods in the living area from Table 9, Th1 (°C)       21       (85)         Utilisation factor for gains for living area, h1,m (see Table 9a) $\overline{Aug}$  | Total g   | ains – ir             | nternal a | and so | olar     | (84)m =   | : (73)m  | + (      | 83)m   | , watts   |                |       | <u>.</u>                                      |          |            | •     |          |      | 1     |      |
| Temperature during heating periods in the living area from Table 9, Th1 (°C)       21 (85)         Utilisation factor for gains for living area, h1,m (see Table 9a)         Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec       (86)m=         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec       (86)m=       0.99       0.98       0.95       0.86       0.7       0.5       0.36       0.81       0.95       0.99       (86)m         Mar       Apr       May       Jun       Jul       Aug       Oct       Nov       Dec       (86)m       (86)m=       20.84       20.87       20.93       20.61       20.61       20.61       20.61       20.61  | (84)m=  | 442.3                 | 451.67    | 449.   | 23       | 438.65    | 424.41   | 4        | 403.5  | 387.5     | 38             | 7.78  | 392.18  | 402      | .27        | 415.8 | 428      | 8.98 |       | (84) |
| Temperature during heating periods in the living area from Table 9, Th1 (°C)       21 (85)         Utilisation factor for gains for living area, h1,m (see Table 9a)         Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec       (86)m=         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec       (86)m=       0.99       0.98       0.95       0.86       0.7       0.5       0.36       0.81       0.95       0.99       (86)m         Mar       Apr       May       Jun       Jul       Aug       Oct       Nov       Dec       (86)m       (86)m=       20.84       20.87       20.93       20.61       20.61       20.61       20.61       20.61  | 7. Mea  | an inter              | nal temp  | beratu | ure (    | heating   | seaso    | n)       |        |           |                |       | -   |          |            |       |          |      |       |      |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$  |   |                       |           |        |          |           |          |          | area   | from Tal  | ble 9          | 9, Th | 1 (°C)  |          |            |       |          |      | 21    | (85) |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$  | Utilisa   | tion fac              | tor for g | ains f | for li   | ving are  | ea, h1,r | n (s     | ee Ta  | ble 9a)   |                |       |   |          |            |       |          |      |       | ]    |
| Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) $(87)m=$ $20.84$ $20.87$ $20.93$ $20.98$ $21$ $21$ $21$ $21$ $21$ $20.99$ $20.93$ $20.83$ (87)Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) $(88)m=$ $20.59$ $20.59$ $20.6$ $20.6$ $20.61$ $20.61$ $20.61$ $20.61$ $20.6$ $20.6$ (88)Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) $(89)m=$ $0.98$ $0.97$ $0.94$ $0.84$ $0.67$ $0.47$ $0.32$ $0.34$ $0.53$ $0.79$ $0.94$ $0.99$ (89)  | [   | Jan                   | Feb       | Ma     | ar       | Apr       | May      | ,        | Jun    | Jul       |                | ٩ug   | Sep   | 0        | ct         | Nov   | D        | ec   |       |      |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$   | (86)m=  | 0.99                  | 0.98      | 0.9    | 5        | 0.86      | 0.7      |          | 0.5    | 0.36      | 0              | .37   | 0.56  | 0.8      | 31         | 0.95  | 0.9      | 99   |       | (86) |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$   | Mean  | interna               | l temper  | ature  | in li    | iving are | ea T1 (  | follo    | w ste  | ns 3 to 7 | 7 in           | Tabl  | e 9c)   |          |            |       |          |      | 1     |      |
| Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) $(88)m=$ $20.59$ $20.59$ $20.6$ $20.6$ $20.61$ $20.61$ $20.61$ $20.61$ $20.6$ <td>г</td> <td></td> <td>· · ·</td> <td></td> <td>-</td> <td></td> <td>,</td> <td>T</td> <td></td> <td></td> <td>1</td> <td></td> <td><u> </u></td> <td>20.</td> <td>99</td> <td>20.93</td> <td>20.</td> <td>.83</td> <td></td> <td>(87)</td>  | г   |                       | · · ·     |        | -        |           | ,        | T        |        |           | 1              |       | <u> </u>                                      | 20.      | 99         | 20.93 | 20.      | .83  |       | (87) |
| (88)m=       20.59       20.59       20.6       20.6       20.61       20.61       20.61       20.61       20.6       20.6       (88)         Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)         (89)m=       0.98       0.97       0.94       0.84       0.67       0.47       0.32       0.34       0.53       0.79       0.94       0.99       (89)   |   |                       |           |        |          |           | reato    | <br>f_du | alling | from To   |                | о т   | الم<br>الم                                    |          |            |       |          |      | I     |      |
| Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)         (89)m=       0.98       0.97       0.94       0.67       0.47       0.32       0.34       0.53       0.79       0.94       0.99       (89)  | Г   | -                     |           | r      | <u> </u> |           |          | -        |        |           | 1              |       | r <u>,                                   </u> | 20       | .6         | 20.6  | 20       | .6   | ]     | (88) |
| (89)m= 0.98 0.97 0.94 0.84 0.67 0.47 0.32 0.34 0.53 0.79 0.94 0.99 (89)  |   |                       |           |        |          |           |          |          |        |           | I              |       |   |          |            |       |          |      | l     | ()   |
|  | г   | -                     |           | r      | -        |           |          | -        |        |           | <del>í í</del> |       | 0.50  | 0-       | <u>, 0</u> | 0.04  | <u> </u> | 20   | 1     | (90) |
|  |   |                       |           |        |          |           |          | _        |        |           |                |       |   |          |            | 0.94  | 0.9      | 99   | l     | (69) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

|   |           |           | -                   |                    |          |                           |                   |                   |                   |            |            |             |           |        |
|---|-----------|-----------|---------------------|--------------------|----------|---------------------------|-------------------|-------------------|-------------------|------------|------------|-------------|-----------|--------|
| (90)m=  | 20.37     | 20.43     | 20.51               | 20.58              | 20.6     | 20.61                     | 20.61             | 20.61             | 20.61             | 20.59      | 20.51      | 20.37       |           | (90)   |
| fLA = Living area ÷ (4) =   |           |           |                     |                    |          |                           |                   |                   | 0.37              | (91)       |            |             |           |        |
| Mean  | interna   | l temper  | ature (fo           | or the wh          | ole dwe  | lling) = fl               | LA × T1           | + (1 – fL         | .A) × T2          |            |            |             |           |        |
| (92)m=  | 20.54     | 20.59     | 20.66               | 20.73              | 20.75    | 20.75                     | 20.75             | 20.76             | 20.75             | 20.74      | 20.66      | 20.54       |           | (92)   |
| Apply   | adjustn   | nent to t | he mear             | interna            | l temper | ature fro                 | m Table           | 4e, whe           | ere appro         | opriate    |            |             |           |        |
| (93)m=  | 20.54     | 20.59     | 20.66               | 20.73              | 20.75    | 20.75                     | 20.75             | 20.76             | 20.75             | 20.74      | 20.66      | 20.54       |           | (93)   |
|   |           |           | uirement            |                    |          |                           |                   |                   |                   |            |            |             |           |        |
| Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a                              |           |           |                     |                    |          |                           |                   |                   |                   |            |            |             |           |        |
|   | Jan       | Feb       | Mar                 | Apr                | May      | Jun                       | Jul               | Aug               | Sep               | Oct        | Nov        | Dec         |           |        |
| Utilisa   | ation fac | tor for g | ains, hm            |                    |          |                           |                   |                   | i                 |            |            |             |           |        |
| (94)m=  | 0.98      | 0.97      | 0.94                | 0.84               | 0.68     | 0.48                      | 0.34              | 0.35              | 0.54              | 0.8        | 0.95       | 0.98        |           | (94)   |
| Useful gains, hmGm , W = (94)m x (84)m  |           |           |                     |                    |          |                           |                   |                   |                   |            |            |             |           |        |
| (95)m=  | 434.03    | 438.11    | 421.57              | 370.35             | 289.28   | 193.15                    | 130.39            | 136.1             | 210.56            | 320.3      | 393.43     | 422.47      |           | (95)   |
|   | <u> </u>  | <u> </u>  | r                   | perature           |          | r                         |                   | 1                 |                   |            |            |             | I         | (00)   |
| (96)m=  | 4.3       | 4.9       | 6.5                 | 8.9                | 11.7     | 14.6                      | 16.6              | 16.4              | 14.1              | 10.6       | 7.1        | 4.2         |           | (96)   |
| Heat<br>(97)m=  | 538.71    | 518.26    | an intern<br>465.77 | al tempe<br>380.98 | 290.16   | Lm , W =<br>193.16        | =[(39)m<br>130.39 | x [(93)m<br>136.1 | – (96)M<br>210.61 | 325.21     | 438.69     | 532.87      |           | (97)   |
|   |           |           |                     |                    |          | Wh/mont                   |                   |                   |                   |            |            | 552.07      |           | (37)   |
| (98)m=  | 77.88     | 53.86     | 32.89               | 7.65               | 0.65     | 0                         |                   | 0                 | 0                 | 3.65       | 32.59      | 82.13       |           |        |
| (/  |           |           |                     |                    |          |                           |                   | Tota              | per vear          |            | ) = Sum(9  |             | 291.3     | (98)   |
| Space   | a hoatin  |           | amont in            | kWh/m²             | lvoar    |                           |                   |                   |                   |            |            |             | 3.74      | (99)   |
|   |           | · ·       |                     |                    | · _      |                           |                   |                   |                   |            |            |             | 3.74      | (00)   |
|   |           |           |                     |                    |          | scheme                    |                   | ting prov         | ided by           | 0.00mm     | unity ook  | omo         |           |        |
| This part is used for space heating, space cooling or water heating provided by a community scheme.<br>Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none |           |           |                     |                    |          |                           |                   |                   |                   | 0          | (301)      |             |           |        |
| Fraction of space heat from community system $1 - (301) =$  |           |           |                     |                    |          |                           |                   |                   |                   |            | 1          | (302)       |           |        |
|   | •         |           |                     |                    |          | rces. The p               | ,                 | allouro for       | CUDand            | un to four | otherheat  |             |           | (002)  |
|   | -         | -         |                     |                    |          | rces. The p<br>from power |                   |                   |                   | up to tour | olner neal | sources, li | ne laller |        |
| Fractic   | on of hea | at from C | Commun              | ity heat           | pump     |                           |                   |                   |                   |            |            |             | 1         | (303a) |
| Fraction of total space heat from Community heat pump (302) × (303a) =  |           |           |                     |                    |          |                           |                   |                   |                   | a) =       | 1          | (304a)      |           |        |
| Factor  | for cont  | rol and o | charging            | method             | (Table   | 4c(3)) fo                 | r commu           | unity hea         | ting sys          | tem        |            |             | 1         | (305)  |
| Distribution loss factor (Table 12c) for community heating system   |           |           |                     |                    |          |                           |                   |                   |                   |            | 1          | (306)       |           |        |
| Space   | heating   | 9         |                     |                    |          |                           |                   |                   |                   |            |            |             | kWh/yea   | r      |
| Annual space heating requirement  |           |           |                     |                    |          |                           |                   |                   | 291.3             |            |            |             |           |        |
| Space heat from Community heat pump(98) x (304a) x (305) x (306) =  |           |           |                     |                    |          |                           |                   |                   | 291.3             | (307a)     |            |             |           |        |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)   |           |           |                     |                    |          |                           |                   |                   |                   | 0          | (308       |             |           |        |
| Space heating requirement from secondary/supplementary system $(98) \times (301) \times 100 \div (308) =$   |           |           |                     |                    |          |                           |                   |                   |                   |            | 0          | (309)       |           |        |
| Water   | heating   | I         |                     |                    |          |                           |                   |                   |                   |            |            |             |           |        |
| Annual water heating requirement  |           |           |                     |                    |          |                           |                   |                   |                   |            | 2071.28    |             |           |        |
| If DHW from community scheme:<br>Water heat from Community heat pump (64) x (303a) x (305) x (306) =  |           |           |                     |                    |          |                           |                   |                   |                   | 2071.28    | (310a)     |             |           |        |
| Electricity used for heat distribution $0.01 \times [(307a)(307e) + (310a)(310e)] =$  |           |           |                     |                    |          |                           |                   |                   | 23.63             | (313)      |            |             |           |        |
|   |           |           |                     |                    |          |                           |                   |                   |                   |            |            |             |           |        |

| Cooling System Energy Efficiency Ratio   |   |                                |        | 0                    | (314)  |  |
|--|---|--------------------------------|--------|----------------------|--------|--|
| Space cooling (if there is a fixed cooling system, i   | f not enter 0) $= (107) \div (314)$                           | = (107) ÷ (314) =              |        |                      |        |  |
| Electricity for pumps and fans within dwelling (Tal mechanical ventilation - balanced, extract or position |   | 182.95                         | (330a) |                      |        |  |
| warm air heating system fans   |   | 0                              | (330b) |                      |        |  |
| pump for solar water heating   |   | 0                              | (330g) |                      |        |  |
| Total electricity for the above, kWh/year  | =(330a) + (330  | =(330a) + (330b) + (330g) =    |        |                      |        |  |
| Energy for lighting (calculated in Appendix L)   |   | 476.95                         | (332)  |                      |        |  |
| Electricity generated by PVs (Appendix M) (negative  |   | -664.99                        | (333)  |                      |        |  |
| Electricity generated by wind turbine (Appendix N  |   | 0                              | (334)  |                      |        |  |
| 12b. CO2 Emissions – Community heating schem   | ne  |                                |        |                      |        |  |
|  | Energy<br>kWh/year  | Emission factors<br>kg CO2/kWh |        | nissions<br>CO2/year |        |  |
| CO2 from other sources of space and water heati<br>Efficiency of heat source 1 (%)                         | ing (not CHP)<br>there is CHP using two fuels repeat (363) to | (366) for the second           | fuel   | 364                  | (367a) |  |
| CO2 associated with heat source 1  | [(307b)+(310b)] x 100 ÷ (367b) x                              | 0.52                           | = [    | 336.86               | (367)  |  |
| Electrical energy for heat distribution  | ((313) x  | 0.52                           | = [    | 12.26                | (372)  |  |
| Total CO2 associated with community systems  | 2)  | = [                            | 349.12 | (373)                |        |  |
| CO2 associated with space heating (secondary)  | 0   | = [                            | 0      | (374)                |        |  |
| CO2 associated with water from immersion heate   | = [   | 0                              | (375)  |                      |        |  |
| Total CO2 associated with space and water heati  | [   | 349.12                         | (376)  |                      |        |  |
| CO2 associated with electricity for pumps and far  | = [   | 94.95                          | (378)  |                      |        |  |
| CO2 associated with electricity for lighting   | (332))) x   | 0.52                           | = [    | 247.54               | (379)  |  |
| Energy saving/generation technologies (333) to (   | 334) as applicable  | 0.52 × 0.01                    | =      | -345.13              | (380)  |  |
| Total CO2, kg/year sum of (37  | 6)(382) =   |                                |        | 346.48               | (383)  |  |
| Dwelling CO2 Emission Rate (383) ÷ (4)   | =   |                                |        | 4.45                 | (384)  |  |
| El rating (section 14)   |   |                                |        | 96.22                | (385)  |  |

| User Details:  |                              |                    |            |             |              |  |                                       |      |                              |             |  |
|--|------------------------------|--------------------|------------|-------------|--------------|--|---------------------------------------|------|------------------------------|-------------|--|
| Assessor Name:<br>Software Name:   | tware Name: Stroma FSAP 2012 |                    |            |             |              | Stroma Number:<br>Software Version: Versio |                                       |      |                              |             |  |
| Property Address: Flat 3   |                              |                    |            |             |              |  |                                       |      |                              |             |  |
| Address :       3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON         1. Overall dwelling dimensions:  |                              |                    |            |             |              |  |                                       |      |                              |             |  |
| Ground floor   |                              |                    | Area<br>4  |             | (1a) x       | (2a) =                                     | <b>Volume(m<sup>3</sup>)</b><br>124.5 | (3a) |                              |             |  |
| Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ 49.8 (4)  |                              |                    |            |             |              |  |                                       |      |                              |             |  |
| Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) =$  |                              |                    |            |             |              |  |                                       |      |                              | (5)         |  |
| 2. Ventilation rate:   |                              |                    |            |             |              |  |                                       |      |                              |             |  |
| Number of chimneys   | heating h                    | econdary<br>eating | / · ·      | other       | 1 = [        | total                                      | x 4                                   | 40 = | m <sup>3</sup> per hour      | ](6a)       |  |
| Number of open flues   | 0 +                          | 0                  | ]          | 0           | ] L<br>] = [ | 0  |                                       | 20 = | 0                            | (6b)        |  |
| Number of intermittent fans $0 \times 10 = 0$  |                              |                    |            |             |              |  |                                       |      | 0                            | (7a)        |  |
| Number of passive vents  |                              |                    |            |             | Ē            | 0  | x 1                                   | 10 = | 0                            | (7b)        |  |
| Number of flueless gas fires   0   x 40 =  |                              |                    |            |             |              |  |                                       |      | 0                            | (7c)        |  |
| Air ch   |                              |                    |            |             |              |  |                                       |      | ange <mark>s per</mark> hour |             |  |
| Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 0 \div (5) = $  |                              |                    |            |             |              |  |                                       |      | 0                            | (8)         |  |
| If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) Number of storeys in the dwelling (ns) Additional infiltration [(9)-1]x0.1 =                                  |                              |                    |            |             |              |  |                                       |      |                              | (9)<br>(10) |  |
| if both types of wall are present, use the value corresponding to the greater wall area (after   |                              |                    |            |             |              |  |                                       |      |                              | (11)        |  |
| deducting areas of openings); if equal user 0.35<br>If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0  |                              |                    |            |             |              |  |                                       |      | 0                            | (12)        |  |
| If no draught lobby, enter 0.05, else enter 0  |                              |                    |            |             |              |  |                                       |      | 0                            | (13)        |  |
| Percentage of windows and doors draught stripped   |                              |                    |            |             |              |  |                                       |      | 0                            | (14)        |  |
| Window infiltration  | 0.25 - [0.2                  | x (14) ÷ 1         | 0          | (15)        |              |  |                                       |      |                              |             |  |
| Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) =$   |                              |                    |            |             |              |  |                                       |      | 0                            | (16)        |  |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area  |                              |                    |            |             |              |  |                                       |      | 2                            | (17)        |  |
| If based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$<br><i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i> (18) |                              |                    |            |             |              |  |                                       |      |                              |             |  |
| Number of sides sheltered  |                              | been done          | e or a deg | iee all pei | meaning      | is being us                                | seu                                   | [    | 3                            | (19)        |  |
| Shelter factor $(20) = 1 - [0.075 \times (19)] =$  |                              |                    |            |             |              |  |                                       |      | 0.78                         | (20)        |  |
| Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$   |                              |                    |            |             |              |  |                                       |      | 0.08                         | (21)        |  |
| Infiltration rate modified fo  | r monthly wind speed         | l                  |            |             |              |  |                                       | ľ    |                              |             |  |
| Jan Feb M  | /lar Apr May                 | Jun                | Jul        | Aug         | Sep          | Oct  | Nov                                   | Dec  |                              |             |  |
| Monthly average wind spe   | ed from Table 7              |                    |            |             |              |  |                                       |      |                              |             |  |
| (22)m= 5.1 5 4   | .9 4.4 4.3                   | 3.8                | 3.8        | 3.7         | 4            | 4.3  | 4.5                                   | 4.7  |                              |             |  |
| Wind Factor (22a)m = $(22)$  | )m ÷ 4                       |                    |            |             |              |  |                                       |      |                              |             |  |
| (22a)m= 1.27 1.25 1  | .23 1.1 1.08                 | 0.95               | 0.95       | 0.92        | 1            | 1.08                                       | 1.12                                  | 1.18 |                              |             |  |

| Adjuste                          | ed infiltra           | ation rat  | e (allowi  | ng for sh               | elter an    | d wind s    | peed) =    | (21a) x      | (22a)m      |                | _                |           |                  |                |
|----------------------------------|-----------------------|------------|------------|-------------------------|-------------|-------------|------------|--------------|-------------|----------------|------------------|-----------|------------------|----------------|
|                                  | 0.1                   | 0.1        | 0.09       | 0.09                    | 0.08        | 0.07        | 0.07       | 0.07         | 0.08        | 0.08           | 0.09             | 0.09      |                  |                |
|                                  | ate effec<br>echanica |            | -          | rate for t              | he appli    | cable ca    | se         |              |             |                |                  |           | 0.5              | (220)          |
|                                  |                       |            |            | endix N, (2             | 3b) = (23a  | a) x Fmv (e | equation ( | N5)) . other | wise (23b   | ) = (23a)      |                  |           | 0.5              | (23a)<br>(23b) |
|                                  |                       |            |            | iency in %              |             |             |            |              |             | ) (200)        |                  |           | 0.5              |                |
|                                  |                       |            | -          | -                       | -           |             |            |              |             | 2b)m i (       | 22h) v [         | 1 – (23c) | 73.1             | (23c)          |
| (24a)m=                          |                       | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21 (24a    | 0.21        | 0.22           | 230) × [<br>0.22 | 0.23      | - 100j           | (24a)          |
|                                  |                       |            |            |                         |             |             |            |              |             |                |                  | 0.20      | l                | (,)            |
| D) II<br>(24b)m=                 |                       |            |            | entilation              |             |             |            | 0 (240       | 0 m = (22)  | 20)m + (.<br>0 | 230)             | 0         | 1                | (24b)          |
|                                  |                       | -          |            | •                       | -           | -           | -          | -            | Ţ           | 0              | 0                | 0         |                  | (240)          |
| ,                                |                       |            |            | ntilation c<br>hen (24c | •           | •           |            |              |             | .5 × (23t      | <b>)</b> )       |           |                  |                |
| (24c)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0              | 0                | 0         |                  | (24c)          |
|                                  |                       |            |            | ole hous                |             |             |            |              |             |                |                  |           | 1                |                |
| i                                | if (22b)m             | n = 1, the | en (24d)   | m = (22k                | o)m othe    | erwise (2   | 4d)m =     | 0.5 + [(2    | 2b)m² x     | 0.5]           |                  |           | 1                |                |
| (24d)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0              | 0                | 0         |                  | (24d)          |
| Effe                             | ctive air             | change     | rate - er  | nter (24a               | ) or (24b   | o) or (24   | c) or (24  | d) in box    | (25)        |                |                  |           |                  |                |
| (25)m=                           | 0.23                  | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21         | 0.21        | 0.22           | 0.22             | 0.23      |                  | (25)           |
| 3. He                            | at losses             | s and he   | eat loss i | oaramete                | er:         |             |            |              |             |                |                  |           |                  | _              |
| ELEN                             |                       | Gros       |            | Openin                  |             | Net Ar      | ea         | U-valu       | Je          | AXU            |                  | k-value   | e                | AXk            |
|                                  |                       | area       |            | 'n                      |             | A ,n        | n²         | W/m2         | K           | (VV/           | K)               | kJ/m²·l   | ĸ                | kJ/K           |
| Windo                            | ws Type               | 1          |            |                         |             | 10.8        | x1/        | [1/( 0.73 )+ | - 0.04] =   | 7.66           |                  |           |                  | (27)           |
| Windo                            | <mark>ws</mark> Type  | 2          |            |                         |             | 2.475       | ; x1/      | [1/( 0.73 )+ | - 0.04] =   | 1.76           |                  |           |                  | (27)           |
| Wall <mark>s</mark> <sup>-</sup> | Type1                 | 19.        | 5          | 10.8                    |             | 8.7         | x          | 0.15         | ] = [       | 1.31           |                  |           |                  | (29)           |
| Walls <sup>-</sup>               | Гуре2                 | 3.5        |            | 2.47                    |             | 1.03        | ×          | 0.15         | <br>  =     | 0.15           | F i              |           | <b>i i</b>       | (29)           |
| Total a                          | rea of el             | lements    | , m²       |                         |             | 23          |            |              |             |                |                  |           |                  | (31)           |
| Party v                          | vall                  |            |            |                         |             | 51.75       | j x        | 0            |             | 0              |                  |           |                  | (32)           |
| Party f                          | _                     |            |            |                         |             | 49.8        | $\exists$  |              | เ           |                | L                |           | $\dashv$         | (32a)          |
| Party c                          | eiling                |            |            |                         |             | 49.8        |            |              |             |                | ĺ                |           | $\exists$        | (32b)          |
| Interna                          | al wall **            |            |            |                         |             | 45.6        |            |              |             |                | [                |           | $\exists \vdash$ | (32c)          |
|                                  |                       |            |            |                         |             |             | ated using | ı formula 1, | /[(1/U-valu | ıe)+0.04] a    | as given in      | paragraph | 3.2              |                |
|                                  | heat los              |            |            | nternal wall            | s and pan   | litions     |            | (26)(30)     | + (32) =    |                |                  |           | 40.07            | (22)           |
|                                  | apacity (             |            |            | 0)                      |             |             |            | (20)(00)     |             | (30) + (32     | 2) + (225)       | (220) -   | 10.87            |                |
|                                  |                       |            | . ,        | - Cm ·                  |             | k l/m2k     |            |              |             | tive Value     | · · · ·          | (326) =   | 13269.5          |                |
|                                  |                       | -          |            | P = Cm ÷                | ,           |             |            | racisaly the |             |                |                  | abla 1f   | 250              | (35)           |
|                                  | used instea           |            |            |                         | constructi  | ion ale not | KIIOWII PI | ecisely life | inucative   | values of      |                  |           |                  |                |
| Therm                            | al bridge             | es : S (L  | x Y) cal   | culated u               | using Ap    | pendix ł    | <          |              |             |                |                  |           | 5.22             | (36)           |
|                                  |                       |            | are not kn | own (36) =              | = 0.05 x (3 | 1)          |            |              |             |                |                  |           |                  |                |
| Total fa                         | abric hea             | at loss    |            |                         |             |             |            |              | (33) +      | (36) =         |                  |           | 16.09            | (37)           |
| Ventila                          | tion hea              | t loss ca  | alculated  | monthly                 | /           |             |            |              | (38)m       | = 0.33 × (     | 25)m x (5        | )         | 1                |                |
|                                  | Jan                   | Feb        | Mar        | Apr                     | May         | Jun         | Jul        | Aug          | Sep         | Oct            | Nov              | Dec       |                  |                |
| (38)m=                           | 9.59                  | 9.51       | 9.43       | 9.03                    | 8.95        | 8.55        | 8.55       | 8.47         | 8.71        | 8.95           | 9.11             | 9.27      |                  | (38)           |
| Heat tr                          | ansfer c              | oefficier  | nt, W/K    |                         |             |             |            |              | (39)m       | = (37) + (     | 38)m             |           |                  |                |
| (39)m=                           | 25.68                 | 25.6       | 25.52      | 25.12                   | 25.04       | 24.64       | 24.64      | 24.56        | 24.8        | 25.04          | 25.2             | 25.36     |                  |                |
| Stroma I                         | FSAP 2012             | 2 Version: | 1.0.4.23   | (SAP 9.92)              | - http://ww | ww.stroma   | .com       |              | 1           | Average =      | Sum(39)1         | 12 /12=   | 25.1p            | age 2 of 39)   |

| Heat loss parameter (HLP), W/m <sup>2</sup> K (40)m = $(39)m \div (4)$ |            |              |                      |              |                |             |             |                        |              |             |                                       |          |         |          |
|--|------------|--------------|----------------------|--------------|----------------|-------------|-------------|------------------------|--------------|-------------|---------------------------------------|----------|---------|----------|
| (40)m=   | 0.52       | 0.51         | 0.51                 | 0.5          | 0.5            | 0.49        | 0.49        | 0.49                   | 0.5          | 0.5         | 0.51                                  | 0.51     |         |          |
| L  | r of dou   |              | nth (Tab             |              |                |             |             |                        | /            | Average =   | Sum(40) <sub>1</sub> .                | 12 /12=  | 0.5     | (40)     |
|  | Jan        | Feb          | Mar                  | Apr          | May            | Jun         | Jul         | Aug                    | Sep          | Oct         | Nov                                   | Dec      |         |          |
| (41)m=   | 31         | 28           | 31                   | 30           | 31             | 30          | 31          | 31                     | 30           | 31          | 30                                    | 31       |         | (41)     |
|  |            |              |                      |              |                |             | -           |                        |              |             |                                       |          |         |          |
| 4. Wat   | ter heat   | ing enei     | rgy requ             | irement:     |                |             |             |                        |              |             |                                       | kWh/ye   | ear:    |          |
| if TFA   |            |              |                      | [1 - exp     | (-0.0003       | 849 x (TF   | -A -13.9    | )2)] + 0.(             | 0013 x (1    | TFA -13     |                                       | 68       |         | (42)     |
| Reduce t   | he annua   | al average   |                      | usage by     | 5% if the a    | lwelling is | designed    | (25 x N)<br>to achieve |              | se target o |                                       | 4.2      |         | (43)     |
|  | Jan        | Feb          | Mar                  | Apr          | May            | Jun         | Jul         | Aug                    | Sep          | Oct         | Nov                                   | Dec      |         |          |
| Hot wate   | r usage ii | n litres per | r day for ea         | ach month    | Vd,m = fa      | ctor from   | Table 1c x  | (43)                   |              |             |                                       |          | I       |          |
| (44)m=   | 81.62      | 78.65        | 75.68                | 72.72        | 69.75          | 66.78       | 66.78       | 69.75                  | 72.72        | 75.68       | 78.65                                 | 81.62    |         | <b>-</b> |
| Energy c   | ontent of  | hot water    | used - cal           | culated mo   | onthly $= 4$ . | 190 x Vd,r  | m x nm x D  | OTm / 3600             |              |             | m(44) <sub>112</sub> =<br>ables 1b, 1 |          | 890.4   | (44)     |
| (45)m=   | 121.04     | 105.86       | 109.24               | 95.24        | 91.38          | 78.86       | 73.07       | 83.85                  | 84.85        | 98.89       | 107.94                                | 117.22   |         | _        |
| lf instanta  | aneous w   | ater heatii  | ng at point          | t of use (no | o hot water    | storage),   | enter 0 in  | boxes (46              |              | Total = Su  | m(45) <sub>112</sub> =                | -        | 1167.46 | (45)     |
| (46)m=   | 18.16      | 15.88        | 16.39                | 14.29        | 13.71          | 11.83       | 10.96       | 12.58                  | 12.73        | 14.83       | 16.19                                 | 17.58    |         | (46)     |
| Water s  | -          |              | includir             | na anv so    | olar or M      | /WHRS       | storage     | within sa              | ame ves      | sel         |                                       | 180      |         | (47)     |
| -  |            |              | and no ta            | -            |                |             |             |                        |              |             |                                       | 100      |         | ()       |
|  | -          | -            |                      |              | -              |             |             | ombi boil              | ers) ente    | er '0' in ( | 47)                                   |          |         |          |
| Water s  | -          |              |                      |              |                |             |             |                        |              |             |                                       |          | L       |          |
|  |            |              | eclared I            |              | or is kno      | wn (kWł     | n/day):     |                        |              |             | 1.                                    | 85       |         | (48)     |
| •  |            |              | m Table              |              |                |             |             |                        |              |             | 0                                     | .6       |         | (49)     |
| •••  |            |              | storage              | -            |                |             |             | (48) x (49)            | ) =          |             | 1.                                    | 11       |         | (50)     |
| ,  |            |              | eclared of factor fr | •            |                |             |             |                        |              |             |                                       | 0        |         | (51)     |
|  |            | -            | ee secti             |              | - (            |             | <i></i>     |                        |              |             |                                       | 0        |         |          |
| Volume   | factor     | from Ta      | ble 2a               |              |                |             |             |                        |              |             |                                       | 0        |         | (52)     |
| Temper   | rature fa  | actor fro    | m Table              | 2b           |                |             |             |                        |              |             |                                       | 0        |         | (53)     |
| •••  |            |              | <sup>-</sup> storage | e, kWh/y€    | ear            |             |             | (47) x (51)            | ) x (52) x ( | 53) =       |                                       | 0        |         | (54)     |
|  |            | 54) in (5    |                      |              |                |             |             |                        |              |             | 1.                                    | 11       |         | (55)     |
| Water s  | storage    | loss cal     | culated              | for each     | month          |             |             | ((56)m = (             | 55) × (41)r  | m           |                                       |          |         |          |
| (56)m=   | 34.41      | 31.08        | 34.41                | 33.3         | 34.41          | 33.3        | 34.41       | 34.41                  | 33.3         | 34.41       | 33.3                                  | 34.41    |         | (56)     |
| If cylinde   | r contains | dedicate     | d solar sto          | rage, (57)   | m = (56)m      | x [(50) – ( | H11)] ÷ (5  | 0), else (5            | 7)m = (56)   | m where (   | H11) is fro                           | m Append | ix H    |          |
| (57)m=   | 34.41      | 31.08        | 34.41                | 33.3         | 34.41          | 33.3        | 34.41       | 34.41                  | 33.3         | 34.41       | 33.3                                  | 34.41    |         | (57)     |
| Primary  | / circuit  | loss (ar     | nnual) fro           | om Table     | e 3            |             |             |                        |              |             |                                       | 0        |         | (58)     |
|  |            |              |                      |              | ,              | ,           | • •         | 65 × (41)              |              |             |                                       |          |         |          |
| Г  |            |              | r                    | i            | 1              | 1           | · · · · · · | ng and a               | · ·          | i           | ,<br>                                 | -        | I       |          |
| (59)m=   | 23.26      | 21.01        | 23.26                | 22.51        | 23.26          | 22.51       | 23.26       | 23.26                  | 22.51        | 23.26       | 22.51                                 | 23.26    |         | (59)     |

| Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$ |                       |               |           |              |                |         |                  |                |               |                     |              |             |               |      |
|---|-----------------------|---------------|-----------|--------------|----------------|---------|------------------|----------------|---------------|---------------------|--------------|-------------|---------------|------|
| (61)m=  | 0                     | 0             | 0         | 0            | 0              | 0       | 0                | 0              | 0             | 0                   | 0            | 0           |               | (61) |
| Total h   | eat req               | uired for     | water h   | neating c    | alculated      | for e   | ach month        | (62)m =        | = 0.85 × (    | (45)m +             | (46)m +      | (57)m +     | (59)m + (61)m |      |
| (62)m=  | 178.71                | 157.95        | 166.91    | 151.05       | 149.06         | 134.6   | 7 130.75         | 141.52         | 140.67        | 156.56              | 163.76       | 174.89      | ]             | (62) |
| Solar DH  | -IW input             | calculated    | using Ap  | pendix G o   | r Appendix     | H (neg  | ative quantity   | y) (enter '(   | )' if no sola | r contribut         | tion to wate | er heating) | -             |      |
| (add a  | dditiona              | al lines if   | FGHRS     | S and/or     | WWHRS          | appli   | es, see Ap       | pendix         | G)            |                     |              |             | _             |      |
| (63)m=  | 0                     | 0             | 0         | 0            | 0              | 0       | 0                | 0              | 0             | 0                   | 0            | 0           |               | (63) |
| Output  | from w                | ater hea      | ter       |              |                |         |                  |                |               |                     |              |             |               |      |
| (64)m=  | 178.71                | 157.95        | 166.91    | 151.05       | 149.06         | 134.6   | 7 130.75         | 141.52         | 140.67        | 156.56              | 163.76       | 174.89      |               | _    |
|   |                       |               | -         |              |                |         |                  | Out            | put from w    | ater heate          | r (annual)₁  | 12          | 1846.5        | (64) |
| Heat g  | ains fro              | m water       | heating   | , kWh/m      | onth 0.2       | 5 ´ [0. | 35 × (45)m       | ı + (61)r      | n] + 0.8 >    | x [(46)m            | + (57)m      | + (59)m     | ]             |      |
| (65)m=  | 86.38                 | 76.87         | 82.46     | 76.32        | 76.52          | 70.8    | 7 70.43          | 74.02          | 72.86         | 79.02               | 80.54        | 85.11       | ]             | (65) |
| inclu   | ide (57)              | m in calo     | culation  | of (65)m     | only if c      | ylinde  | r is in the      | dwelling       | or hot w      | ater is f           | rom com      | munity h    | -<br>neating  |      |
| 5. Int  | ternal g              | ains (see     | e Table   | 5 and 5a     | ):             |         |                  |                |               |                     |              |             |               |      |
| Metab   | olic daii             | ns (Table     | e 5). Wa  | itts         | ,              |         |                  |                |               |                     |              |             |               |      |
|   | Jan                   | Feb           | Mar       | Apr          | May            | Ju      | n Jul            | Aug            | Sep           | Oct                 | Nov          | Dec         |               |      |
| (66)m=  | 84.21                 | 84.21         | 84.21     | 84.21        | 84.21          | 84.2    | 1 84.21          | 84.21          | 84.21         | 8 <mark>4.21</mark> | 84.21        | 84.21       |               | (66) |
| Lightin   | g gains               | ,<br>(calcula | ted in A  | ppendix      | L, equat       | ion L9  | or L9a), a       | lso see        | Table 5       |                     |              |             |               |      |
| (67)m=  | 17.77                 | 15.79         | 12.84     | 9.72         | 7.27           | 6.13    | 6.63             | 8.62           | 11.56         | 14.68               | 17.14        | 18.27       |               | (67) |
| Applia  | nces ga               | ains (calc    | ulated i  | n Appen      | dix L, eq      | uation  | L13 or L1        | 3a), also      | see Ta        | ble 5               |              |             | 1             |      |
| (68)m=  | 146.71                | 148.24        | 144.4     | 136.23       | 125.92         | 116.2   |                  | 108.24         | 112.07        | 120.24              | 130.55       | 140.24      |               | (68) |
| Cookir  | ng gains              | s (calcula    | ted in A  |              | L. equat       | ion L'  | 5 or L15a        | ), also s      | ee Table      | 5                   |              |             | 1             |      |
| (69)m=  | 31.42                 | 31.42         | 31.42     | 31.42        | 31.42          | 31.4    |                  | 31.42          | 31.42         | 31.42               | 31.42        | 31.42       |               | (69) |
| Pumps   | and fa                | ins gains     | (Table    | 5a)          |                |         |                  |                |               |                     |              |             |               |      |
| (70)m=  | 0                     | 0             | 0         | 0            | 0              | 0       | 0                | 0              | 0             | 0                   | 0            | 0           | ]             | (70) |
| Losses  | se.a.e                | vaporatic     | n (nega   | ative valu   | ı<br>les) (Tab | le 5)   |                  | I              | 1             | <u> </u>            | 1            | I           | 1             |      |
|   | -67.37                | <u> </u>      | <u> </u>  | 1            | -67.37         | -67.3   | 7 -67.37         | -67.37         | -67.37        | -67.37              | -67.37       | -67.37      | ]             | (71) |
|   |                       | ı<br>gains (T |           |              | ļ              |         |                  |                | 1             | <b></b>             | 1            |             | 1             |      |
| (72)m=  | 116.11                | 114.39        | 110.83    | 1            | 102.85         | 98.4    | 3 94.67          | 99.49          | 101.2         | 106.21              | 111.86       | 114.4       | 1             | (72) |
|   |                       | l gains =     | I         |              |                | (       | <br>66)m + (67)m | L<br>1 + (68)m |               |                     |              | I           | 1             |      |
| (73)m=  | 328.86                |               | 316.34    | 300.21       | 284.31         | 269.0   |                  | 264.6          | 273.1         | 289.39              | 307.81       | 321.17      | 1             | (73) |
|   | lar gain              | 1             |           |              |                |         |                  |                |               |                     |              |             |               | · ,  |
|   |                       |               | using sol | ar flux from | Table 6a       | and ass | ociated equa     | ations to c    | onvert to th  | ne applicat         | ole orientat | ion.        |               |      |
| Orienta   | ation:                | Access F      | actor     | Area         | l              | F       | lux              |                | g_            |                     | FF           |             | Gains         |      |
|   |                       | Table 6d      |           | m²           |                | -       | able 6a          | 1              | Table 6b      | Т                   | able 6c      |             | (W)           |      |
| Southe  | ast <mark>0.9x</mark> | 0.77          | )         | 2.4          | 47             | ×       | 36.79            | x              | 0.63          | x                   | 0.1          | =           | 3.98          | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77          | ,         | 2.4          | 47             | × 🗌     | 62.67            | × [            | 0.63          |                     | 0.1          | =           | 6.77          | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77          | ,         | 2.4          | 47             | × 🗌     | 85.75            | × [            | 0.63          |                     | 0.1          | =           | 9.27          | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77          |           | 2.4          | 47             | × 🗌     | 106.25           | × [            | 0.63          |                     | 0.1          | =           | 11.48         | (77) |
| Southe  | ast <mark>0.9x</mark> | 0.77          | >         | 2.4          | 47             | x       | 119.01           | × [            | 0.63          | × [                 | 0.1          | =           | 12.86         | (77) |

| Southeast 0.9x 0.77 x 2.47 x 118.15 x 0.63 x 0.1 = 12.77 (77)   |   |  |  |  |   |  |   |   |   |   |   |       |  |  |
|---|---|--|--|--|---|--|---|---|---|---|---|-------|--|--|
| Southeast 0.9x  | 0.77  | x  | 2.47   | x  | 118.  | .15  | x   | 0.63  | ×   | 0.1   | =   | 12.77 | (77)   |  |
| Southeast 0.9x  | 0.77  | x  | 2.47   | x  | 113.  | .91  | x   | 0.63  | <b>x</b>  | 0.1   | =   | 12.31 | (77)   |  |
| Southeast 0.9x  | 0.77  | x  | 2.47   | x  | 104.  | 39   | x   | 0.63  | _ x [   | 0.1   | =   | 11.28 | (77)   |  |
| Southeast 0.9x  | 0.77  | x  | 2.47   | ×  | 92.8  | 35   | x   | 0.63  | ×   | 0.1   | =   | 10.03 | (77)   |  |
| Southeast 0.9x  | 0.77  | x  | 2.47   | ×  | 69.2  | 27   | x   | 0.63  | x   | 0.1   | =   | 7.48  | (77)   |  |
| Southeast 0.9x  | 0.77  | ×  | 2.47   | ×  | 44.0  | 07   | x   | 0.63  | <b>x</b>  | 0.1   | =   | 4.76  | (77)   |  |
| Southeast 0.9x  | 0.77  | ×  | 2.47   | ×  | 31.4  | 49   | x   | 0.63  | <b>x</b>  | 0.1   | =   | 3.4   | (77)   |  |
| Southwest0.9x   | 0.77  | x  | 10.8   | ×  | 36.7  | 79   |   | 0.63  | _ × [   | 0.1   | =   | 17.35 | (79)   |  |
| Southwest0.9x   | 0.77  | x  | 10.8   | ×  | 62.6  | 67   |   | 0.63  | x [   | 0.1   | =   | 29.55 | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | ×  | 85.7  | 75   |   | 0.63  | _ × [   | 0.1   | =   | 40.43 | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | ×  | 106.  | 25   |   | 0.63  |   | 0.1   | =   | 50.1  | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | ×  | 119.  | .01  |   | 0.63  |   | 0.1   | =   | 56.12 | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | ×  | 118.  | .15  |   | 0.63  | <br>× [   | 0.1   |   | 55.71 | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | ×  | 113.  | .91  |   | 0.63  |   | 0.1   |   | 53.71 | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | ×  | 104.  | 39   |   | 0.63  | <br>× [   | 0.1   | =   | 49.22 | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | - ×  | 92.8  | 35   |   | 0.63  | <br>× [   | 0.1   |   | 43.78 | (79)   |  |
| Southwest0.9x   | 0.77  | ×  | 10.8   | ×  | 69.2  | 27   |   | 0.63  |   | 0.1   |   | 32.66 | (79)   |  |
| Sout <mark>hwest<sub>0.9x</sub></mark>  | vesto.9x 0.77 x 10  |  |  |  | 44.0  | 07   |   | 0.63  | x   | 0.1   | =   | 20.78 | (79)   |  |
| Sout <mark>hwest<sub>0.9x</sub></mark>  |   |  |  |  |   |  |   |   |   |   |   |       |  |  |
| Solar gains ir  |   |  |  |  |   |  |   |   |   |   |   |       |  |  |
|   |   |  |  |  | 68 48 6   |  | 60.5  | Sum(74)m .  |   | 25.54   | 18 25   |       | (83)   |  |
|   |   |  |  |  |   |  |   |   |   |   | .0.20   |       |  |  |
| (83)m=       21.32       36.32       49.7       61.58       68.98       68.48       66.02       60.5       53.81       40.15       25.54       18.25       (83)         Total gains – internal and solar (84)m = (73)m + (83)m , watts  |   |  |  |  |   |  |   |   |   |   |   |       |  |  |
| (84)m= 350.18   | (84)m=         350.18         363         366.04         361.79         353.28         337.54         325.34         325.11         329.54         333.36         339.42         (84)           7. Mean internal temperature (heating season)         6 |  |  |  |   |  |   |   |   |   |   |       |  |  |
|   |   |  |  |  | 337.54 3  | 325.34   | 325.11  | 326.91  | 329.54  | 333.36  | 339.42  |       | (84)   |  |
| 7. Mean inte  |   | ature (  | heating sea  | son)   |   |  |   |   | 329.54  | 333.36  | 339.42  | 21    | (84)   |  |
| 7. Mean inte<br>Temperature   | ernal tempera   | ature (<br>ting pe   | heating sea<br>eriods in the   | son)<br>living   | area fro  | om Table   |   |   | 329.54  | 333.36  | 339.42  | 21    | _  |  |
| 7. Mean inte<br>Temperature   | ernal tempera<br>e during hea<br>actor for gain   | ature (<br>ting pe   | heating sea<br>eriods in the<br>ving area, h   | son)<br>living   | area fro  | om Table   |   |   | 329.54  | 333.36<br>Nov   | 339.42<br>Dec                                 | 21    | _  |  |
| 7. Mean inte<br>Temperature<br>Utilisation fa   | ernal tempera<br>e during hea<br>actor for gain<br>Feb  | ature (<br>ting pe<br>s for li   | heating sea<br>eriods in the<br>ving area, h   | son)<br>living<br>1,m (ຄ<br>ay   | area fro<br>see Table<br>Jun  | om Table<br>e 9a)  | e 9, Tl   | n1 (°C)   |   |   |   | 21    | _  |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97   | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 (  | ature (<br>ting pe<br>s for li<br>Mar<br>0.91  | heating sea<br>eriods in the<br>ving area, h<br>Apr N<br>0.81 0.6  | son)<br>living<br>1,m (s<br>ay   | area fro<br>see Table<br>Jun<br>0.47  | om Table<br>e 9a)<br>Jul<br>0.33   | e 9, Tl<br>Aug<br>0.35  | n1 (°C)<br>Sep<br>0.52  | Oct   | Nov   | Dec   | 21    | (85)   |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97   | ernal temperate<br>during heat<br>actor for gain<br>Feb<br>0.96 (c)<br>al temperatu   | ature (<br>ting pe<br>s for li<br>Mar<br>0.91  | heating sea<br>eriods in the<br>ving area, h<br>Apr N<br>0.81 0.6  | son)<br>living<br>1,m (s<br>ay<br>56   | area fro<br>see Table<br>Jun<br>0.47  | om Table<br>e 9a)<br>Jul<br>0.33   | e 9, Tl<br>Aug<br>0.35  | n1 (°C)<br>Sep<br>0.52  | Oct   | Nov   | Dec   | 21    | (85)   |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97<br>Mean intern<br>(87)m= 20.81  | ernal temperate<br>e during hea<br>actor for gain<br>Feb<br>0.96<br>0.96<br>0.96<br>0.96<br>20.86<br>2  | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>tre in l<br>0.92  | heating sea<br>eriods in the<br>ving area, h<br>Apr M<br>0.81 0.6<br>iving area T<br>20.98 2   | son)<br>living<br>1,m (s<br>ay<br>36<br>1 (follo   | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21  | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21   | e 9, Tl<br><u>Aug</u><br>0.35<br>in Tab<br>21   | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21  | Oct<br>0.77   | Nov<br>0.93   | Dec<br>0.98                                   | 21    | (85)   |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97<br>Mean intern<br>(87)m= 20.81<br>Temperature   | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 (c)<br>al temperatu<br>20.86 2<br>e during hea   | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>tre in l<br>0.92  | heating sea<br>eriods in the<br>ving area, h<br>Apr M<br>0.81 0.6<br>iving area T<br>20.98 2   | son)<br>living<br>1,m (s<br>ay<br>1 (follo<br>1<br>t of dv   | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fro   | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab   | e 9, Tl<br><u>Aug</u><br>0.35<br>in Tab<br>21   | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21  | Oct<br>0.77   | Nov<br>0.93   | Dec<br>0.98                                   | 21    | (85)   |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97<br>Mean intern<br>(87)m= 20.81<br>Temperature<br>(88)m= 20.51   | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 (0<br>al temperatu<br>20.86 2<br>e during hea<br>20.51 2   | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>ure in l<br>0.92<br>ting po<br>0.51                                       | heating seaeriods in theving area, hAprN0.810.6iving area T20.982eriods in res20.5220.   | son)<br>living<br>1,m (s<br>ay<br>1 (follo<br>1<br>t of dv<br>52   | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fro<br>20.53  | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab<br>20.53  | e 9, Tl<br>Aug<br>0.35<br>in Tab<br>21<br>ile 9, T<br>20.53                             | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21<br>Th2 (°C)  | Oct<br>0.77<br>20.99                                    | Nov<br>0.93<br>20.91  | Dec<br>0.98<br>20.8                           | 21    | (85)<br>(86)<br>(87)                         |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97<br>Mean intern<br>(87)m= 20.81<br>Temperature<br>(88)m= 20.51<br>Utilisation fa   | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 0<br>al temperatu<br>20.86 2<br>e during hea<br>20.51 2<br>actor for gain  | ature (<br>ting pe<br>s for li<br>Mar<br>0.91<br>ire in l<br>0.92<br>ting pe<br>0.51<br>s for r                            | heating seaeriods in theving area, hAprN0.810.6iving areaT20.982eriods in res20.5220.est of dwelli   | son)<br>living<br>1,m (s<br>ay<br>56<br>1 (folle<br>1<br>1 (folle<br>1<br>52<br>ng, h2   | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fro<br>20.53<br>2,m (see  | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab<br>20.53<br>Table 9                                   | e 9, Tl<br>Aug<br>0.35<br>in Tab<br>21<br>le 9, T<br>20.53                              | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21<br>Th2 (°C)<br>20.52                                     | Oct<br>0.77<br>20.99<br>20.52                           | Nov<br>0.93<br>20.91<br>20.52   | Dec<br>0.98<br>20.8<br>20.51                  | 21    | (85)<br>(86)<br>(87)<br>(88)                 |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97<br>Mean intern<br>(87)m= 20.81<br>Temperature<br>(88)m= 20.51<br>Utilisation fa<br>(89)m= 0.97  | ernal temperate<br>e during hea<br>actor for gain<br>Feb<br>0.96 0<br>al temperatu<br>20.86 2<br>e during hea<br>20.51 2<br>actor for gain<br>0.95 0  | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>ire in l<br>0.92<br>ting po<br>0.51<br>s for r<br>0.9                     | heating seaeriods in theving area, hAprM0.810.6iving areaT20.982eriods in res20.5220.est of dwellii0.790.6   | son)<br>living<br>1,m (s<br>ay<br>56<br>1 (folle<br>1<br>1 (folle<br>1<br>1<br>52<br>52<br>52<br>52  | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fro<br>20.53<br>2<br>2,m (see<br>0.43                             | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab<br>20.53<br>Table 9<br>0.3                            | e 9, Tl<br>Aug<br>0.35<br>in Tab<br>21<br>20.53<br>0a)<br>0.31                          | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21<br>Th2 (°C)<br>20.52<br>0.49                             | Oct<br>0.77<br>20.99<br>20.52<br>0.74                   | Nov<br>0.93<br>20.91  | Dec<br>0.98<br>20.8                           | 21    | (85)<br>(86)<br>(87)                         |  |
| 7. Mean interval $7$ . Mean interval $7$ . Mean interval $7$ . Utilisation fails (86)m= $0.97$<br>Mean interm (87)m= $20.81$<br>Temperature (88)m= $20.51$<br>Utilisation fails (89)m= $0.97$<br>Mean interm  | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 0<br>al temperatu<br>20.86 2<br>e during hea<br>20.51 2<br>actor for gain<br>0.95 a<br>al temperatu  | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>ure in l<br>0.92<br>ting po<br>0.51<br>s for r<br>0.9                     | heating sea         eriods in the         ving area, h         Apr       N         0.81       0.6         iving area T         20.98       2         eriods in res         20.52       20.         est of dwellin         0.79       0.6         he rest of dv | son)<br>living<br>1,m (s<br>ay<br>1 (follo<br>1<br>1 (follo<br>1<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1 | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fro<br>20.53<br>2<br>2,m (see<br>0.43<br>g T2 (follo              | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab<br>20.53<br>Table 9<br>0.3<br>ow step                 | e 9, Tl<br>Aug<br>0.35<br>in Tab<br>21<br>ile 9, 1<br>20.53<br>0.31<br>0.31<br>os 3 to  | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21<br>h2 (°C)<br>20.52<br>0.49<br>7 in Table                | Oct<br>0.77<br>20.99<br>20.52<br>0.74<br>e 9c)          | Nov<br>0.93<br>20.91<br>20.52<br>0.92   | Dec<br>0.98<br>20.8<br>20.51<br>0.97          | 21    | (85)<br>(86)<br>(87)<br>(88)<br>(89)         |  |
| 7. Mean inter<br>Temperature<br>Utilisation fa<br>(86)m= 0.97<br>Mean intern<br>(87)m= 20.81<br>Temperature<br>(88)m= 20.51<br>Utilisation fa<br>(89)m= 0.97  | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 0<br>al temperatu<br>20.86 2<br>e during hea<br>20.51 2<br>actor for gain<br>0.95 a<br>al temperatu  | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>ire in l<br>0.92<br>ting po<br>0.51<br>s for r<br>0.9                     | heating seaeriods in theving area, hAprM0.810.6iving areaT20.982eriods in res20.5220.est of dwellii0.790.6   | son)<br>living<br>1,m (s<br>ay<br>1 (follo<br>1<br>1 (follo<br>1<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1 | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fre<br>20.53<br>2<br>2,m (see<br>0.43<br>g T2 (follow             | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab<br>20.53<br>Table 9<br>0.3<br>ow step                 | e 9, Tl<br>Aug<br>0.35<br>in Tab<br>21<br>20.53<br>0a)<br>0.31                          | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21<br>Th2 (°C)<br>20.52<br>0.49<br>7 in Table<br>20.52      | Oct<br>0.77<br>20.99<br>20.52<br>0.74<br>e 9c)<br>20.51 | Nov           0.93           20.91           20.52           0.92           20.41 | Dec<br>0.98<br>20.8<br>20.51<br>0.97<br>20.25 |       | (85)<br>(86)<br>(87)<br>(88)<br>(89)<br>(90) |  |
| 7. Mean interval $7$ . Mean interval $7$ . Mean interval $7$ . Utilisation fails (86)m= $0.97$<br>Mean interm (87)m= $20.81$<br>Temperature (88)m= $20.51$<br>Utilisation fails (89)m= $0.97$<br>Mean interm  | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 0<br>al temperatu<br>20.86 2<br>e during hea<br>20.51 2<br>actor for gain<br>0.95 a<br>al temperatu  | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>ure in l<br>0.92<br>ting po<br>0.51<br>s for r<br>0.9                     | heating sea         eriods in the         ving area, h         Apr       N         0.81       0.6         iving area T         20.98       2         eriods in res         20.52       20.         est of dwellin         0.79       0.6         he rest of dv | son)<br>living<br>1,m (s<br>ay<br>1 (follo<br>1<br>1 (follo<br>1<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1<br>52<br>1 | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fro<br>20.53<br>2<br>2,m (see<br>0.43<br>g T2 (follo              | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab<br>20.53<br>Table 9<br>0.3<br>ow step                 | e 9, Tl<br>Aug<br>0.35<br>in Tab<br>21<br>ile 9, 1<br>20.53<br>0.31<br>0.31<br>os 3 to  | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21<br>Th2 (°C)<br>20.52<br>0.49<br>7 in Table<br>20.52      | Oct<br>0.77<br>20.99<br>20.52<br>0.74<br>e 9c)<br>20.51 | Nov<br>0.93<br>20.91<br>20.52<br>0.92   | Dec<br>0.98<br>20.8<br>20.51<br>0.97<br>20.25 | 0.47  | (85)<br>(86)<br>(87)<br>(88)<br>(89)         |  |
| 7. Mean intervention of the formula | ernal tempera<br>e during hea<br>actor for gain<br>Feb<br>0.96 0<br>al temperatu<br>20.86 2<br>e during hea<br>20.51 2<br>actor for gain<br>0.95 a<br>al temperatu  | ature (<br>ting po<br>s for li<br>Mar<br>0.91<br>ire in l<br>0.92<br>ting po<br>0.51<br>s for r<br>0.9<br>ure in t<br>0.42 | heating seaeriods in theving area, hAprM0.810.6iving areaT20.982eriods in res20.5220.est of dwellii0.790.6he rest of dw20.520.   | son)<br>living<br>1,m (s<br>ay<br>56<br>1 (foll(<br>1<br>1<br>1<br>52<br>52<br>52<br>52  | area fro<br>see Table<br>Jun<br>0.47<br>ow steps<br>21<br>velling fro<br>20.53<br>2<br>c,m (see<br>0.43<br>g T2 (folk<br>20.53<br>2 | om Table<br>e 9a)<br>Jul<br>0.33<br>3 to 7 i<br>21<br>om Tab<br>20.53<br>Table 9<br>0.3<br>0.3<br>ow step<br>20.53 | e 9, Tl<br>Aug<br>0.35<br>in Tab<br>21<br>20.53<br>0.31<br>0.31<br>0.31<br>0.31<br>0.53 | n1 (°C)<br>Sep<br>0.52<br>le 9c)<br>21<br>Th2 (°C)<br>20.52<br>0.49<br>7 in Table<br>20.52<br>f | Oct<br>0.77<br>20.99<br>20.52<br>0.74<br>e 9c)<br>20.51 | Nov           0.93           20.91           20.52           0.92           20.41 | Dec<br>0.98<br>20.8<br>20.51<br>0.97<br>20.25 |       | (85)<br>(86)<br>(87)<br>(88)<br>(89)<br>(90) |  |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

|  | <del> </del>     | <del> </del>  |                                | 1                             | 1             | 1                   | 1            |             |         | (00)   |  |  |  |  |
|--|------------------|---------------|--------------------------------|-------------------------------|---------------|---------------------|--------------|-------------|---------|--------|--|--|--|--|
| (93)m= 20.52 20.58   | 20.66 20.72      | 20.74 20      | 0.75 20.75                     | 20.75                         | 20.75         | 20.73               | 20.65        | 20.51       |         | (93)   |  |  |  |  |
| 8. Space heating request<br>Set Ti to the mean information of the set of the se |                  | ura obtainad  | at stop 11 o                   | f Tabla O                     | h co tha      | t Ti m_(            | 76)m an      | d ro, colo  | ulato   |        |  |  |  |  |
| the utilisation factor for   |                  |               |                                |                               | 0, 50 illa    | u 11,111=(          | n ojin an    | u le-caic   | uiale   |        |  |  |  |  |
| Jan Feb  | Mar Apr          | May 、         | Jun Jul                        | Aug                           | Sep           | Oct                 | Nov          | Dec         |         |        |  |  |  |  |
| Utilisation factor for g   | ains, hm:        |               |                                |                               |               |                     |              |             |         |        |  |  |  |  |
| (94)m= 0.97 0.95   | 0.9 0.8          | 0.64 0        | .45 0.31                       | 0.33                          | 0.5           | 0.76                | 0.92         | 0.97        |         | (94)   |  |  |  |  |
| Useful gains, hmGm   | , W = (94)m x (8 | 34)m          |                                |                               |               |                     |              |             |         |        |  |  |  |  |
| (95)m= 338.57 344.02   | 330.62 288.94    | 225.52 15     | 1.46 102.2                     | 106.8                         | 164.75        | 249.44              | 306.94       | 330.09      |         | (95)   |  |  |  |  |
| Monthly average exte   | r i              | T T           |                                | 1                             |               |                     |              | · · · · · · | l       |        |  |  |  |  |
| (96)m= 4.3 4.9   | 6.5 8.9          |               | 4.6 16.6                       | 16.4                          | 14.1          | 10.6                | 7.1          | 4.2         |         | (96)   |  |  |  |  |
| Heat loss rate for me  | · · · · ·        |               |                                | 1 /                           | r <u>, ,</u>  | r <del>ī</del>      |              | 440.50      |         | (07)   |  |  |  |  |
| (97)m= 416.48 401.35   | 361.22 296.95    |               | 1.48 102.2                     | 106.8                         | 164.82        | 253.71              | 341.39       | 413.52      |         | (97)   |  |  |  |  |
| Space heating require<br>(98)m= 57.96 38.53  | 22.77 5.77       |               | $\frac{\text{month} = 0.0}{0}$ | $\frac{124 \times [(97)]}{0}$ | )m – (95<br>0 | 3.18 3.18           | 1)m<br>24.81 | 62.07       |         |        |  |  |  |  |
| (90)11= 37.90 30.33  | 22.11 5.11       | 0.05          | 0 0                            |                               |               |                     |              |             | 015 70  | (98)   |  |  |  |  |
|  |                  | - /           |                                | TOLA                          | ii per year   | (kwn/yea            | r) = Sum(9   | 0)15,912 =  | 215.73  | (98)   |  |  |  |  |
| Space heating requirement in kWh/m²/year 4.33  |                  |               |                                |                               |               |                     |              |             |         |        |  |  |  |  |
| 9b. Energy requiremer  |                  |               |                                |                               |               |                     |              |             |         |        |  |  |  |  |
| 9b. Energy requirements – Community heating scheme<br>This part is used for space heating, space cooling or water heating provided by a community scheme.<br>Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none  |                  |               |                                |                               |               |                     |              |             |         |        |  |  |  |  |
|  |                  |               |                                |                               |               |                     |              |             |         |        |  |  |  |  |
|  |                  | (302)         |                                |                               |               |                     |              |             |         |        |  |  |  |  |
| The community scheme ma<br>includes boilers, heat pump   | he latter        |               |                                |                               |               |                     |              |             |         |        |  |  |  |  |
| Fraction of heat from (  |                  |               | ,                              |                               |               |                     |              | [           | 1       | (303a) |  |  |  |  |
| Fraction of total space  | heat from Com    | munity heat   | pump                           |                               |               | (3                  | 02) x (303   | a) =        | 1       | (304a) |  |  |  |  |
| Factor for control and   |                  |               |                                | unity hea                     | ating sys     | tem                 |              |             | 1       | (305)  |  |  |  |  |
| Distribution loss factor   | (Table 12c) for  | community h   | neating syste                  | em                            |               |                     |              |             | 1       | (306)  |  |  |  |  |
| Space heating  |                  | -             |                                |                               |               |                     |              | I           | kWh/yea | <br>r  |  |  |  |  |
| Annual space heating   | requirement      |               |                                |                               |               |                     |              |             | 215.73  |        |  |  |  |  |
| Space heat from Com  | munity heat pun  | ηp            |                                |                               | (98) x (30    | 04a) x (30          | 5) x (306)   | =           | 215.73  | (307a) |  |  |  |  |
| Efficiency of secondar   | y/supplementar   | y heating sys | stem in % (fr                  | om Table                      | e 4a or A     | ppendix             | E)           |             | 0       | (308   |  |  |  |  |
| Space heating require  | ment from seco   | ndary/supple  | mentary sys                    | stem                          | (98) x (30    | 01) x 100 ·         | ÷ (308) =    |             | 0       | (309)  |  |  |  |  |
| Water heating  |                  |               |                                |                               |               |                     |              | •           |         |        |  |  |  |  |
| Annual water heating   | requirement      |               |                                |                               |               |                     |              | [           | 1846.5  |        |  |  |  |  |
| If DHW from communi<br>Water heat from Comr  |                  | D             |                                |                               | (64) x (30    | 03a) x (30          | 5) x (306) : | -           | 1846.5  | (310a) |  |  |  |  |
| Electricity used for hea   |                  |               |                                | 0.01                          | × [(307a).    | (307e) <del>+</del> | ⊦ (310a)…(   | (310e)] =   | 20.62   | (313)  |  |  |  |  |
| Cooling System Energ   |                  | io            |                                |                               |               |                     |              |             | 0       | (314)  |  |  |  |  |
| Space cooling (if there  |                  |               | not enter 0)                   |                               | = (107) ÷     | - (314) =           |              |             | 0       | (315)  |  |  |  |  |
| Electricity for pumps a  |                  |               |                                |                               |               |                     |              | l           |         |        |  |  |  |  |
| mechanical ventilation   |                  |               |                                | n outside                     |               |                     |              |             | 116.96  | (330a) |  |  |  |  |
|  |                  |               |                                |                               |               |                     |              | -           |         |        |  |  |  |  |

| warm air heating system fans   |                             | 0          | (330b) |
|--|-----------------------------|------------|--------|
| pump for solar water heating   |                             | 0          | (330g) |
| Total electricity for the above, kWh/year                              | =(330a) + (330b) + (330g) = | 116.96     | (331)  |
| Energy for lighting (calculated in Appendix L)                         |                             | 313.91     | (332)  |
| Electricity generated by PVs (Appendix M) (negative quantity)          |                             | -664.99    | (333)  |
| Electricity generated by wind turbine (Appendix M) (negative quantity) |                             | 0          | (334)  |
| 12b. CO2 Emissions – Community heating scheme                          |                             |            |        |
| <b>F</b> -   | arms Emission feator        | Emissions. |        |

|  | Energy<br>kWh/year           | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |        |
|--|------------------------------|-------------------------------|--------------------------|--------|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) If there is CHP using | ng two fuels repeat (363) to | (366) for the second fu       | el 364                   | (367a) |
| CO2 associated with heat source 1 [(307b)  | +(310b)] x 100 ÷ (367b) x    | 0.52                          | = 294.04                 | (367)  |
| Electrical energy for heat distribution  | [(313) x                     | 0.52                          | = 10.7                   | (372)  |
| Total CO2 associated with community systems  | (363)(366) + (368)(372       | 2)                            | = 304.74                 | (373)  |
| CO2 associated with space heating (secondary)  | (309) x                      | 0                             | = 0                      | (374)  |
| CO2 associated with water from immersion heater or instantan   | eous heater (312) x          | 0.52                          | = 0                      | (375)  |
| Total CO2 associated with space and water heating  | (373) + (374) + (375) =      |                               | 304.74                   | (376)  |
| CO2 associated with electricity for pumps and fans within dwel   | ling (331)) x                | 0.52                          | = 60.7                   | (378)  |
| CO2 associated with electricity for lighting   | (332))) x                    | 0.52                          | = 162.92                 | (379)  |
| Energy saving/generation technologies (333) to (334) as applied tem 1  | cable                        | 0.52 x 0.01 =                 | -345.13                  | (380)  |
| Total CO2, kg/year sum of (376)(382) =   |                              |                               | 183.23                   | (383)  |
| Dwelling CO2 Emission Rate (383) ÷ (4) =   |                              |                               | 3.68                     | (384)  |
| El rating (section 14)   |                              |                               | 97.41                    | (385)  |

|  |                               |                         | User De      | etails:                      |            |                 |                       |           |                                       |              |
|--|-------------------------------|-------------------------|--------------|------------------------------|------------|-----------------|-----------------------|-----------|---------------------------------------|--------------|
| Assessor Name:<br>Software Name:   | Stroma FSAP 201               |                         | ;            | Stroma<br>Softwa<br>\ddress: | re Ver     |                 |                       | Versio    | n: 1.0.4.23                           |              |
| Addross I  | 3 Bed Flat, 219-223           |                         |              |                              |            | nh lunct        | ion I ON              |           |                                       |              |
| Address :<br>1. Overall dwelling dimer   |                               | Columan                 |              | ie, Loug                     | προιοαί    | JII JUIICI      | ION, LON              |           |                                       |              |
| Ground floor   |                               |                         | <b>Area</b>  |                              | (1a) x     | <b>Av. He</b> i | <b>ight(m)</b><br>2.5 | (2a) =    | <b>Volume(m<sup>3</sup>)</b><br>231.5 | (3a)         |
| Total floor area TFA = (1a   | )+(1b)+(1c)+(1d)+(1e          | e)+(1n)                 | 9            | 2.6                          | (4)        |                 |                       |           |                                       |              |
| Dwelling volume  |                               |                         |              |                              | (3a)+(3b)  | +(3c)+(3d       | l)+(3e)+              | .(3n) =   | 231.5                                 | (5)          |
| 2. Ventilation rate:   |                               |                         |              |                              |            |                 |                       |           |                                       |              |
| Number of chimneys   |                               | econdary<br>eating<br>0 | ′ (<br>] + [ | other                        | 1 = [      | total           | x 4                   | 40 =      | m <sup>3</sup> per hour               | (6a)         |
| Number of open flues   | 0 +                           | 0                       | ] + [        | 0                            | ] = [      | 0               | x2                    | 20 =      | 0                                     | (6b)         |
| Number of intermittent far   | IS                            |                         |              |                              | Ĺ          | 0               | x ´                   | 10 =      | 0                                     | (7a)         |
| Number of passive vents  |                               |                         |              |                              |            | 0               | x ^                   | 10 =      | 0                                     | _<br>(7b)    |
| Number of flueless gas fir   | es                            |                         |              |                              |            | 0               | X 4                   | 40 =      | 0                                     | (7c)         |
|  |                               |                         |              |                              |            |                 |                       | Air ch    | anges per ho                          | ur           |
| Infiltration due to chimney  |                               |                         |              |                              |            | 0               |                       | ÷ (5) =   | 0                                     | (8)          |
| Number of storeys in th<br>Additional infiltration   | e dw <mark>elling</mark> (ns) |                         |              |                              |            |                 |                       | -1]x0.1 = | 0                                     | (9)<br>(10)  |
| Structural infiltration: 0.2<br>if both types of wall are pre-<br>deducting areas of opening | esent, use the value corres   |                         |              |                              |            | uction          |                       |           | 0                                     | (11)         |
| If suspended wooden fle  | oor, enter 0.2 (unseal        | ed) or 0.1              | (sealed      | d), else                     | enter 0    |                 |                       |           | 0                                     | (12)         |
| If no draught lobby, ente  | er 0.05, else enter 0         |                         |              |                              |            |                 |                       |           | 0                                     | (13)         |
| Percentage of windows  | and doors draught st          | ripped                  |              |                              |            |                 |                       |           | 0                                     | (14)         |
| Window infiltration  |                               |                         |              | ).25 - [0.2                  |            |                 | . (45)                |           | 0                                     | (15)         |
| Infiltration rate<br>Air permeability value, o   | 750 overessed in sub          | via motros              |              | (8) + (10) -                 |            |                 |                       | aroa      | 0                                     | (16)         |
| If based on air permeabilit  | • • •                         |                         | •            | •                            | •          |                 | invelope              | alea      | 0.1                                   | (17)<br>(18) |
| Air permeability value applies   |                               |                         |              |                              |            | is being us     | sed                   | l         | 0.1                                   |              |
| Number of sides sheltered  | k                             |                         |              |                              |            |                 |                       | [         | 2                                     | (19)         |
| Shelter factor   |                               |                         | (            | 20) = 1 - [                  | 0.075 x (1 | 9)] =           |                       |           | 0.85                                  | (20)         |
| Infiltration rate incorporation  | ng shelter factor             |                         | (            | 21) = (18)                   | x (20) =   |                 |                       |           | 0.08                                  | (21)         |
| Infiltration rate modified fo  |                               | <u> </u>                |              |                              |            |                 | 1                     |           |                                       |              |
| Jan Feb I  | Mar Apr May                   | Jun                     | Jul          | Aug                          | Sep        | Oct             | Nov                   | Dec       |                                       |              |
| Monthly average wind spe   | - i i                         |                         |              |                              |            |                 |                       |           |                                       |              |
| (22)m= 5.1 5   | 4.9 4.4 4.3                   | 3.8                     | 3.8          | 3.7                          | 4          | 4.3             | 4.5                   | 4.7       |                                       |              |
| Wind Factor (22a)m = (22   | ,<br>1 1                      | ,                       | r            |                              |            |                 |                       | ,         |                                       |              |
| (22a)m= 1.27 1.25 1  | .23 1.1 1.08                  | 0.95                    | 0.95         | 0.92                         | 1          | 1.08            | 1.12                  | 1.18      |                                       |              |

| Adjuste  | ed infiltr             | ation rat               | e (allow       | ing for sh                    | elter an    | d wind s      | peed) =         | : (21a) x     | (22a)m       |                |                       |           |           |               |
|----------|------------------------|-------------------------|----------------|-------------------------------|-------------|---------------|-----------------|---------------|--------------|----------------|-----------------------|-----------|-----------|---------------|
|          | 0.11                   | 0.11                    | 0.1            | 0.09                          | 0.09        | 0.08          | 0.08            | 0.08          | 0.08         | 0.09           | 0.1                   | 0.1       |           |               |
|          |                        | ctive air<br>al ventila | -              | rate for t                    | he applic   | cable ca      | se              |               |              |                |                       |           | 0.5       | (23a)         |
|          |                        |                         |                | endix N, (2                   | 3b) = (23a  | ) × Fmv (e    | equation (      | N5)) . othe   | rwise (23b   | ) = (23a)      |                       |           | 0.5       | (23a)         |
|          |                        |                         |                | ciency in %                   |             |               |                 |               |              | , ( ,          |                       |           | 73.1      | (23c)         |
|          |                        |                         | -              | entilation                    | -           |               |                 |               |              | 2h)m + (       | 23b) x [ <sup>/</sup> | 1 – (23c) |           | (200)         |
| (24a)m=  |                        | 0.24                    | 0.24           | 0.23                          | 0.23        | 0.22          | 0.22            | 0.21          | 0.22         | 0.23           | 0.23                  | 0.23      | . 100]    | (24a)         |
|          |                        | d mech                  | ı<br>anical ve | entilation                    | without     | heat rec      | L<br>coverv (l  | 1<br>MV) (24t | (22)         | 1<br>2b)m + () | 1<br>23b)             |           |           |               |
| (24b)m=  | 0                      | 0                       | 0              | 0                             | 0           | 0             | 0               | 0             | 0            | 0              | 0                     | 0         |           | (24b)         |
| c) If    | whole h                | use ex                  | r<br>tract ver | ntilation c                   | r positiv   | e input v     | ı<br>ventilatio | n from o      | utside       |                |                       |           |           |               |
| ,        |                        |                         |                | then (24c                     | •           | •             |                 |               |              | .5 × (23t      | <b>)</b> )            |           |           |               |
| (24c)m=  | 0                      | 0                       | 0              | 0                             | 0           | 0             | 0               | 0             | 0            | 0              | 0                     | 0         |           | (24c)         |
| ,        |                        |                         |                | ole hous                      | •           | •             |                 |               |              |                |                       |           |           |               |
|          | · ,                    | r                       | r <u>, ,</u>   | )m = (22b                     | · · · · · · |               | ,<br>           | 1             | <u> </u>     | r -            | r .                   |           |           |               |
| (24d)m=  | 0                      | 0                       | 0              | 0                             | 0           | 0             | 0               | 0             | 0            | 0              | 0                     | 0         |           | (24d)         |
|          |                        |                         | <b></b>        | nter (24a                     | <u> </u>    | , 、           | ŕ               | <del>,</del>  | r`´´         | 0.00           | 0.00                  | 0.00      |           | (25)          |
| (25)m=   | 0.24                   | 0.24                    | 0.24           | 0.23                          | 0.23        | 0.22          | 0.22            | 0.21          | 0.22         | 0.23           | 0.23                  | 0.23      |           | (25)          |
| 3. Hea   | at l <mark>osse</mark> | s and he                | eat loss       | paramete                      | er:         |               |                 |               |              |                | _                     |           |           |               |
| ELEN     | 1ENT                   | Gros                    |                | Openin<br>m                   |             | Net Ar        |                 | U-val<br>W/m2 |              | AXU            |                       | k-value   |           | A X k<br>kJ/K |
| Window   | ws Type                | are <mark>a</mark>      | (111-)         |                               |             | A ,r<br>10.98 |                 | /[1/( 0.73 )· |              | (W/            |                       | KJ/11-•r  | `         | KJ/K<br>(27)  |
|          | ws Type                |                         |                |                               |             |               |                 | /[1/( 0.73 )· |              |                | H                     |           |           |               |
|          | ws Type                |                         |                |                               |             | 2.7           |                 | /[1/( 0.73 )· |              | 1.92           | 2                     |           |           | (27)          |
| Walls 1  |                        |                         |                |                               |             | 2.7           |                 |               |              | 1.92           | ╘┤╷                   |           |           | (27)          |
|          |                        | 34.                     |                | 10.98                         | 3           | 23.52         |                 | 0.15          | =            | 3.53           | ╡╏                    |           | $\dashv$  | (29)          |
| Walls 7  |                        | 12.                     |                | 2.7                           |             | 9.8           | ×               | 0.15          |              | 1.47           | ╡╎                    |           | $\dashv$  | (29)          |
| Walls 7  |                        | 23.2                    |                | 2.7                           |             | 20.55         |                 | 0.15          | =            | 3.08           |                       |           |           | (29)          |
|          |                        | lements                 | , m²           |                               |             | 70.25         | 5               |               |              |                | —                     |           |           | (31)          |
| Party v  |                        |                         |                |                               |             | 47            | ×               | 0             | =            | 0              | [                     |           | $\dashv$  | (32)          |
| Party fl |                        |                         |                |                               |             | 92.6          |                 |               |              |                | Ĺ                     |           | $\exists$ | (32a)         |
| Party c  | -                      |                         |                |                               |             | 92.6          |                 |               |              |                | Ļ                     |           | $\exists$ | (32b)         |
|          | l wall **              |                         |                |                               |             | 146.5         |                 |               |              |                | Ļ                     |           |           | (32c)         |
|          |                        |                         |                | effective wil<br>nternal wall |             |               | ated using      | g formula 1   | /[(1/U-valu  | ie)+0.04] a    | as given in           | paragraph | 3.2       |               |
|          |                        | s, W/K                  |                |                               | ,           |               |                 | (26)(30       | ) + (32) =   |                |                       |           | 19.7      | (33)          |
| Heat ca  | apacity                | Cm = S(                 | (Axk)          |                               |             |               |                 |               | ((28).       | (30) + (32     | 2) + (32a).           | (32e) =   | 19835.    | 1 (34)        |
| Therma   | al mass                | parame                  | eter (TMI      | P = Cm ÷                      | TFA) in     | kJ/m²K        |                 |               | Indica       | tive Value     | : Medium              |           | 250       | (35)          |
|          | -                      |                         |                | etails of the                 | constructi  | on are not    | t known p       | recisely the  | e indicative | e values of    | TMP in Ta             | able 1f   |           |               |
|          |                        | ad of a de              |                |                               |             | ا المعامم     | /               |               |              |                |                       | 1         |           |               |
|          | -                      |                         |                | lculated u                    |             |               | ^               |               |              |                |                       |           | 7.32      | (36)          |
|          | abric he               |                         | are not Kr     | 10wn (36) =                   | 0.00 X (3   | 1)            |                 |               | (33) +       | (36) =         |                       |           | 27.02     | (37)          |
|          |                        |                         |                |                               |             |               |                 |               |              |                |                       |           |           | ` ,           |

| Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$ |            |                     |                    |                         |                |             |                                       |                        |               |                      |                                       |         | _       |      |
|---|------------|---------------------|--------------------|-------------------------|----------------|-------------|---------------------------------------|------------------------|---------------|----------------------|---------------------------------------|---------|---------|------|
| [   | Jan        | Feb                 | Mar                | Apr                     | May            | Jun         | Jul                                   | Aug                    | Sep           | Oct                  | Nov                                   | Dec     |         |      |
| (38)m=  | 18.55      | 18.39               | 18.23              | 17.42                   | 17.26          | 16.44       | 16.44                                 | 16.28                  | 16.77         | 17.26                | 17.58                                 | 17.91   |         | (38) |
| Heat tra  | ansfer c   | oefficie            | nt, W/K            |                         |                |             |                                       |                        | (39)m         | = (37) + (3          | 38)m                                  |         |         |      |
| (39)m=  | 45.57      | 45.41               | 45.25              | 44.44                   | 44.27          | 43.46       | 43.46                                 | 43.3                   | 43.79         | 44.27                | 44.6                                  | 44.92   |         |      |
|   |            |                     |                    |                         |                |             |                                       |                        |               |                      | Sum(39)                               | 12 /12= | 44.4    | (39) |
| г   | 0.49 0.49  | 0.49                | HLP), W/           | 0.48                    | 0.48           | 0.47        | 0.47                                  | 0.47                   | (40)m<br>0.47 | = (39)m ÷<br>0.48    | 0.48                                  | 0.49    |         |      |
| (40)m=  | 0.49       | 0.49                | 0.49               | 0.40                    | 0.40           | 0.47        | 0.47                                  | 0.47                   |               |                      | 0.40<br>Sum(40)1                      |         | 0.48    | (40) |
| Numbe   | r of day   | rs in mo            | nth (Tab           | le 1a)                  |                |             |                                       |                        | ,             | Wordgo -             | Cum(40)1                              |         | 0.40    |      |
| [   | Jan        | Feb                 | Mar                | Apr                     | Мау            | Jun         | Jul                                   | Aug                    | Sep           | Oct                  | Nov                                   | Dec     |         |      |
| (41)m=  | 31         | 28                  | 31                 | 30                      | 31             | 30          | 31                                    | 31                     | 30            | 31                   | 30                                    | 31      |         | (41) |
| _   |            |                     |                    |                         |                |             |                                       |                        |               |                      |                                       |         |         |      |
| 4. Wat  | ter heat   | ing ene             | rgy requ           | irement:                |                |             |                                       |                        |               |                      |                                       | kWh/ye  | ear:    |      |
| Assum   | ed occu    | pancy,              | N                  |                         |                |             |                                       |                        |               |                      |                                       | 00      |         | (42) |
|   |            |                     |                    | [1 - exp                | (-0.0003       | 49 x (TF    | -<br>A -13.9                          | )2)] + 0.0             | )013 x (      | FFA -13.             |                                       | .66     |         | (42) |
|   | A £ 13.9   |                     |                    |                         |                |             |                                       | (05 N))                |               |                      |                                       |         | 1       |      |
|   |            |                     |                    |                         |                |             |                                       | (25 x N)<br>to achieve |               | se target o          | 97<br>f                               | .37     |         | (43) |
| not more  | that 125   | litres per          | person pe          | r day (all w            | ater use, l    | not and co  | ld)                                   |                        |               |                      |                                       |         |         |      |
|   | Jan        | Feb                 | Mar                | Apr                     | May            | Jun         | Jul                                   | Aug                    | Sep           | Oct                  | Nov                                   | Dec     |         |      |
| Hot wate  | r usage ii | n litres per        | r day for ea       | ach m <mark>onth</mark> | Vd,m = fa      | ctor from T | Table 1c x                            | (43)                   |               |                      |                                       |         |         |      |
| (44)m=  | 107.1      | 103.21              | 99.31              | 95.42                   | 91.52          | 87.63       | 87.63                                 | 91.52                  | 95.42         | 99.31                | 103.21                                | 107.1   |         | _    |
| Energy c  | ontent of  | hot water           | used - cal         | culated mo              | onthly $= 4$ . | 190 x Vd,r  | n x nm x E                            | 0Tm / 3600             |               |                      | m(44) <sub>112</sub> =<br>ables 1b, 1 |         | 1168.4  | (44) |
| (45)m=  | 158.83     | 138.92              | 143.35             | 124 <mark>.97</mark>    | 119.92         | 103.48      | 95. <mark>8</mark> 9                  | 110.03                 | 111.35        | 12 <mark>9.76</mark> | 141.65                                | 153.82  |         |      |
| lf instanta   | aneous w   | ater heati          | ng at point        | of use (no              | hot water      | • storage), | enter 0 in                            | boxes (46              |               | Total = Su           | m(45) <sub>112</sub> =                | -       | 1531.96 | (45) |
| (46)m=  | 23.82      | 20.84               | 21.5               | 18.75                   | 17.99          | 15.52       | 14.38                                 | 16.5                   | 16.7          | 19.46                | 21.25                                 | 23.07   |         | (46) |
| Water 5   | -          |                     |                    |                         |                |             |                                       |                        |               |                      |                                       |         | 1       |      |
| -   |            | . ,                 |                    |                         |                |             | -                                     | within sa              | ame ves       | sel                  |                                       | 180     | l       | (47) |
| Otherw  | ise if no  | stored              |                    | nk in dw<br>er (this ir | •              |             |                                       | (47)<br>ombi boil      | ers) ente     | er '0' in (          | 47)                                   |         |         |      |
| Water s<br>a) If ma   | -          |                     | eclared I          | oss facto               | or is kno      | wn (kWł     | n/dav):                               |                        |               |                      |                                       | 0       |         | (48) |
| ,   |            |                     | m Table            |                         |                | X           | , , , , , , , , , , , , , , , , , , , |                        |               |                      |                                       | 0       |         | (49) |
|   |            |                     |                    | , kWh/ye                | ear            |             |                                       | (48) x (49)            | ) =           |                      |                                       | 80      |         | (50) |
| b) If ma  | anufact    | urer's de           | eclared o          | cylinder l              | oss fact       |             |                                       |                        |               |                      |                                       |         |         |      |
|   |            | -                   |                    | om Tabl                 | e 2 (kW        | h/litre/da  | ıy)                                   |                        |               |                      | 0.                                    | .01     |         | (51) |
|   |            | eating s<br>from Ta | ee secti<br>ble 2a | on 4.3                  |                |             |                                       |                        |               |                      | 0                                     | 87      |         | (52) |
|   |            |                     | m Table            | 2b                      |                |             |                                       |                        |               |                      |                                       | .6      |         | (52) |
|   |            |                     |                    | , kWh/ye                | ear            |             |                                       | (47) x (51)            | ) x (52) x (  | 53) =                |                                       | .97     |         | (54) |
|   |            | 54) in (5           |                    |                         |                |             |                                       |                        |               |                      |                                       | 97      |         | (55) |
| Water s   | storage    | loss cal            | culated            | for each                | month          |             |                                       | ((56)m = (             | 55) × (41)    | m                    |                                       |         |         |      |
| (56)m=  | 30.09      | 27.18               | 30.09              | 29.12                   | 30.09          | 29.12       | 30.09                                 | 30.09                  | 29.12         | 30.09                | 29.12                                 | 30.09   |         | (56) |

| If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$ , else $(57)m = (56)m$ where (H11) is from Appendix H |               |            |             |                         |           |                          |              |              |                           |             |             |               |      |
|---|---------------|------------|-------------|-------------------------|-----------|--------------------------|--------------|--------------|---------------------------|-------------|-------------|---------------|------|
| (57)m= 30.09  | 9 27.18       | 30.09      | 29.12       | 30.09                   | 29.12     | 30.09                    | 30.09        | 29.12        | 30.09                     | 29.12       | 30.09       |               | (57) |
| Primary circ  | uit loss (ar  | nnual) fro | om Table    | e 3                     | -         |                          |              | -            |                           |             | 0           |               | (58) |
| Primary circ  |               | ,          |             |                         | 59)m = (  | (58) ÷ 36                | 65 × (41)    | m            |                           |             |             |               |      |
| (modified   | by factor f   | rom Tab    | le H5 if t  | here is s               | solar wat | ter heatii               | ng and a     | cylinde      | r thermo                  | stat)       |             |               |      |
| (59)m= 23.20  | 6 21.01       | 23.26      | 22.51       | 23.26                   | 22.51     | 23.26                    | 23.26        | 22.51        | 23.26                     | 22.51       | 23.26       |               | (59) |
| Combi loss o  | calculated    | for each   | n month (   | (61)m =                 | (60) ÷ 36 | 65 × (41)                | )m           |              |                           |             |             |               |      |
| (61)m= 0  | 0             | 0          | 0           | 0                       | 0         | 0                        | 0            | 0            | 0                         | 0           | 0           |               | (61) |
| Total heat re   | quired for    | water h    | eating ca   | alculated               | for eac   | h month                  | (62)m =      | 0.85 × (     | (45)m +                   | (46)m +     | (57)m +     | (59)m + (61)m |      |
| (62)m= 212.1  | 9 187.11      | 196.7      | 176.61      | 173.27                  | 155.11    | 149.24                   | 163.39       | 162.98       | 183.12                    | 193.28      | 207.17      |               | (62) |
| Solar DHW inp   | ut calculated | using App  | endix G or  | Appendix                | H (negati | ve quantity              | y) (enter '0 | ' if no sola | r contribut               | ion to wate | er heating) |               |      |
| (add addition   | nal lines if  | FGHRS      | and/or V    | WWHRS                   | applies   | , see Ap                 | pendix (     | G)           |                           | -           |             |               |      |
| (63)m= 0  | 0             | 0          | 0           | 0                       | 0         | 0                        | 0            | 0            | 0                         | 0           | 0           |               | (63) |
| Output from   | water hea     | ter        |             |                         |           |                          |              |              |                           |             |             |               |      |
| (64)m= 212.1  | 9 187.11      | 196.7      | 176.61      | 173.27                  | 155.11    | 149.24                   | 163.39       | 162.98       | 183.12                    | 193.28      | 207.17      |               |      |
|   | _             |            |             |                         |           |                          | Outp         | out from wa  | ater heate                | r (annual)₁ | 12          | 2160.16       | (64) |
| Hea <mark>t gains f</mark>  | rom water     | heating    | , kWh/mo    | onth 0.2                | 5´[0.85   | × (45)m                  | n + (61)m    | n] + 0.8 >   | k [(46)m                  | + (57)m     | + (59)m     | ]             |      |
| (65)m= 95.49  | 84.74         | 90.35      | 82.86       | 82.55                   | 75.71     | 74.57                    | 79.27        | 78.33        | 85.83                     | 88.4        | 93.83       |               | (65) |
| in <mark>clude</mark> (5  | 7)m in cal    | culation   | of (65)m    | only i <mark>f</mark> c | ylinder i | s in th <mark>e</mark> o | dwelling     | or hot w     | ate <mark>r is f</mark> r | om com      | munity h    | eating        |      |
| 5. Internal   | gains (see    | e Table {  | 5 and 5a)   | ):                      |           |                          |              |              |                           |             |             |               |      |
| Metabolic ga  | ains (Table   | e 5), Wat  | ts          |                         |           |                          |              |              |                           |             |             |               |      |
| Jar   |               | Mar        | Apr         | May                     | Jun       | Jul                      | Aug          | Sep          | Oct                       | Nov         | Dec         |               |      |
| (66)m= 132.9  | 8 132.98      | 132.98     | 132.98      | 132.98                  | 132.98    | 132.98                   | 132.98       | 132.98       | 132.98                    | 132.98      | 132.98      |               | (66) |
| Lighting gair   | ns (calcula   | ted in A   | opendix     | L, equat                | ion L9 o  | r L9a), a                | lso see      | Table 5      |                           |             |             |               |      |
| (67)m= 30.40  | 3 27.06       | 22         | 16.66       | 12.45                   | 10.51     | 11.36                    | 14.76        | 19.82        | 25.16                     | 29.37       | 31.31       |               | (67) |
| Appliances (  | gains (calc   | ulated ir  | n Append    | dix L, eq               | uation L  | 13 or L1                 | 3a), also    | see Ta       | ble 5                     |             | _           |               |      |
| (68)m= 243.7  | 8 246.31      | 239.94     | 226.36      | 209.23                  | 193.13    | 182.38                   | 179.85       | 186.22       | 199.79                    | 216.92      | 233.02      |               | (68) |
| Cooking gai   | ns (calcula   | ated in A  | ppendix     | L, equat                | ion L15   | or L15a)                 | ), also se   | e Table      | 5                         |             |             |               |      |
| (69)m= 36.3   | 36.3          | 36.3       | 36.3        | 36.3                    | 36.3      | 36.3                     | 36.3         | 36.3         | 36.3                      | 36.3        | 36.3        |               | (69) |
| Pumps and   | fans gains    | (Table     | 5a)         |                         |           |                          |              |              |                           |             |             |               |      |
| (70)m= 0  | 0             | 0          | 0           | 0                       | 0         | 0                        | 0            | 0            | 0                         | 0           | 0           |               | (70) |
| Losses e.g.   | evaporatio    | n (nega    | tive valu   | es) (Tab                | le 5)     |                          | •            |              |                           |             |             |               |      |
| (71)m= -106.3   | 9 -106.39     | -106.39    | -106.39     | -106.39                 | -106.39   | -106.39                  | -106.39      | -106.39      | -106.39                   | -106.39     | -106.39     |               | (71) |
| Water heatir  | ng gains (1   | Fable 5)   |             | <u> </u>                |           |                          |              |              |                           |             |             |               |      |
| (72)m= 128.3  | 5 126.1       | 121.43     | 115.08      | 110.96                  | 105.16    | 100.22                   | 106.54       | 108.79       | 115.36                    | 122.78      | 126.11      |               | (72) |
| Total intern  | al gains =    |            |             |                         | (66)      | m + (67)m                | n + (68)m +  | ⊦ (69)m + (  | (70)m + (7                | 1)m + (72)  | m           |               |      |
| (73)m= 465.4  | _ <u>_</u>    | 446.27     | 421         | 395.54                  | 371.7     | 356.85                   | 364.05       | 377.72       | 403.21                    | 431.97      | 453.34      |               | (73) |
| 6. Solar ga   | ins:          |            |             |                         |           |                          |              |              |                           |             |             |               |      |
| Solar gains ar  | e calculated  | using sola | r flux from | Table 6a                | and assoc | iated equa               | ations to co | onvert to th | e applicat                | le orientat | ion.        |               |      |
| Orientation:  |               |            | Area        |                         | Flu       |                          |              | g_           |                           | FF          |             | Gains         |      |
|   | Table 6d      |            | m²          |                         | Tal       | ble 6a                   | Т            | able 6b      | Ta                        | able 6c     |             | (W)           |      |

| Northeast 0.9x            | 0.77 | x | 2.7   | x | 11.28  | × | 0.63 | x | 0.1 | ] = | 1.33  | (75) |
|---------------------------|------|---|-------|---|--------|---|------|---|-----|-----|-------|------|
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 22.97  | × | 0.63 | x | 0.1 | =   | 2.71  | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 41.38  | x | 0.63 | x | 0.1 | =   | 4.88  | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 67.96  | × | 0.63 | x | 0.1 | ] = | 8.01  | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | × | 91.35  | × | 0.63 | x | 0.1 | ] = | 10.77 | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 97.38  | x | 0.63 | x | 0.1 | =   | 11.48 | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 91.1   | × | 0.63 | x | 0.1 | =   | 10.74 | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 72.63  | × | 0.63 | x | 0.1 | =   | 8.56  | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 50.42  | × | 0.63 | x | 0.1 | ] = | 5.94  | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 28.07  | × | 0.63 | x | 0.1 | ] = | 3.31  | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | × | 14.2   | × | 0.63 | x | 0.1 | ] = | 1.67  | (75) |
| Northeast 0.9x            | 0.77 | x | 2.7   | x | 9.21   | × | 0.63 | x | 0.1 | =   | 1.09  | (75) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 36.79  | × | 0.63 | x | 0.1 | ] = | 4.34  | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 62.67  | × | 0.63 | x | 0.1 | =   | 7.39  | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 85.75  | × | 0.63 | x | 0.1 | =   | 10.11 | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 106.25 | x | 0.63 | x | 0.1 | =   | 12.52 | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 119.01 | x | 0.63 | x | 0.1 | =   | 14.03 | (77) |
| Southeast 0.9x            | 0.77 | х | 2.7   | X | 118.15 | х | 0.63 | x | 0.1 | =   | 13.93 | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 113.91 | x | 0.63 | x | 0.1 | =   | 13.43 | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 104.39 | × | 0.63 | x | 0.1 | =   | 12.31 | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 92.85  | x | 0.63 | x | 0.1 | =   | 10.95 | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | × | 69.27  | x | 0.63 | x | 0.1 | =   | 8.17  | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 44.07  | × | 0.63 | x | 0.1 | =   | 5.2   | (77) |
| Southeast 0.9x            | 0.77 | x | 2.7   | x | 31.49  | x | 0.63 | x | 0.1 | =   | 3.71  | (77) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 36.79  |   | 0.63 | x | 0.1 | =   | 17.64 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 62.67  |   | 0.63 | x | 0.1 | =   | 30.04 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 85.75  |   | 0.63 | x | 0.1 | =   | 41.11 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 106.25 |   | 0.63 | x | 0.1 | =   | 50.93 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 119.01 |   | 0.63 | x | 0.1 | =   | 57.05 | (79) |
| Southwest0.9x             | 0.77 | x | 10.98 | x | 118.15 |   | 0.63 | x | 0.1 | =   | 56.64 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 113.91 |   | 0.63 | x | 0.1 | =   | 54.61 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 104.39 |   | 0.63 | x | 0.1 | =   | 50.04 | (79) |
| Southwest0.9x             | 0.77 | x | 10.98 | × | 92.85  | ] | 0.63 | x | 0.1 | ] = | 44.51 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 69.27  | ] | 0.63 | x | 0.1 | ] = | 33.21 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | × | 44.07  | ] | 0.63 | x | 0.1 | ] = | 21.13 | (79) |
| Southwest <sub>0.9x</sub> | 0.77 | x | 10.98 | x | 31.49  | ] | 0.63 | x | 0.1 | ] = | 15.09 | (79) |

| Solar gains in watts, calculated for each month(83)m = Sum(74)m(82)m                      |   |          |          |           |             |           |          |           |        |       |       |       | _    |        |
|---|---|----------|----------|-----------|-------------|-----------|----------|-----------|--------|-------|-------|-------|------|--------|
| (83)m=  | 23.31   | 40.14    | 56.09    | 71.47     | 81.85       | 82.05     | 78.77    | 70.91     | 61.4   | 44.68 | 27.99 | 19.89 |      | (83)   |
| Total gains – internal and solar (84)m = (73)m + (83)m , watts                            |   |          |          |           |             |           |          |           |        |       |       |       | •    |        |
| (84)m= 488.79 502.5 502.36 492.47 477.39 453.74 435.62 434.96 439.12 447.89 459.96 473.23 |   |          |          |           |             |           |          |           |        |       |       |       | (84) |        |
| 7. Mean internal temperature (heating season)   |   |          |          |           |             |           |          |           |        |       |       |       |      |        |
| Temp  | erature   | during h | eating p | eriods ir | n the livir | ng area f | from Tab | ole 9, Th | 1 (°C) |       |       |       | 21   | (85)   |
| Utilisa   | Utilisation factor for gains for living area, h1,m (see Table 9a) |          |          |           |             |           |          |           |        |       |       |       |      |        |
| lan Feb Mar Anr May Jun Jul Aug Sen Oct Nov Dec   |   |          |          |           |             |           |          |           |        |       |       |       | Page | 5 of 7 |

| (86)m=  | 1         | 0.99       | 0.99             | 0.95       | 0.83          | 0.61       | 0.44         | 0.46          | 0.68         | 0.93       | 0.99                   | 1          | 1         | (86)   |
|---------|-----------|------------|------------------|------------|---------------|------------|--------------|---------------|--------------|------------|------------------------|------------|-----------|--------|
|         |           |            |                  |            |               |            |              |               |              | 0.93       | 0.99                   | 1          |           | (00)   |
|         |           | i İ        | i                | <u> </u>   | r ·           | r          | i            | 7 in Tabl     | <u> </u>     | 00.05      | 00.04                  | 00.07      | 1         | (07)   |
| (87)m=  | 20.68     | 20.73      | 20.81            | 20.92      | 20.98         | 21         | 21           | 21            | 21           | 20.95      | 20.81                  | 20.67      |           | (87)   |
|         |           | i Č        |                  | î          | î             | 1          | T            | able 9, T     | <u>, , ,</u> | r          | r                      |            | 1         |        |
| (88)m=  | 20.53     | 20.53      | 20.53            | 20.54      | 20.54         | 20.55      | 20.55        | 20.55         | 20.55        | 20.54      | 20.54                  | 20.53      |           | (88)   |
| Utilisa | ation fac | tor for g  | ains for         | rest of d  | welling,      | h2,m (se   | ee Table     | 9a)           | -            | -          |                        |            |           |        |
| (89)m=  | 1         | 0.99       | 0.98             | 0.93       | 0.8           | 0.57       | 0.39         | 0.41          | 0.64         | 0.91       | 0.99                   | 1          |           | (89)   |
| Mean    | interna   | l temper   | ature in         | the rest   | of dwell      | ing T2 (f  | ollow ste    | eps 3 to 3    | 7 in Tabl    | e 9c)      |                        |            |           |        |
| (90)m=  | 20.1      | 20.17      | 20.29            | 20.44      | 20.53         | 20.55      | 20.55        | 20.55         | 20.54        | 20.48      | 20.29                  | 20.09      |           | (90)   |
|         |           |            |                  |            |               |            |              | -             | I            | LA = Livin | g area ÷ (4            | 4) =       | 0.35      | (91)   |
| Mean    | interna   | l temper   | ature (fo        | or the wh  | ole dwe       | llina) = f | LA x T1      | + (1 – fL     | A) x T2      |            |                        |            |           |        |
| (92)m=  | 20.31     | 20.37      | 20.47            | 20.61      | 20.69         | 20.71      | 20.71        | 20.71         | 20.7         | 20.65      | 20.47                  | 20.3       | ]         | (92)   |
| Apply   | adjustr   | nent to t  | he mear          | n interna  | I temper      | ature fro  | n<br>Table   | e 4e, whe     | ere appro    | opriate    |                        |            | 1         |        |
| (93)m=  | 20.31     | 20.37      | 20.47            | 20.61      | 20.69         | 20.71      | 20.71        | 20.71         | 20.7         | 20.65      | 20.47                  | 20.3       |           | (93)   |
| 8. Spa  | ace hea   | iting requ | uirement         | t          |               |            |              |               |              |            |                        |            |           |        |
|         |           |            |                  |            |               | ned at st  | ep 11 of     | Table 9       | o, so tha    | t Ti,m=(   | 76)m an                | d re-calc  | culate    |        |
| the ut  |           | factor fo  | Ŭ                | <u> </u>   | i             |            | <u> </u>     |               |              |            |                        |            | 1         |        |
| L LOPE  | Jan       | Feb        | Mar              | Apr        | May           | Jun        | Jul          | Aug           | Sep          | Oct        | Nov                    | Dec        |           |        |
|         | 0.99      | tor for g  | ains, hm<br>0.98 | n:<br>0.94 | 0.81          | 0.58       | 0.41         | 0.43          | 0.66         | 0.91       | 0.00                   | 1          | 1         | (94)   |
| (94)m=  |           | hmGm       |                  |            |               | 0.58       | 0.41         | 0.43          | 0.66         | 0.91       | 0.98                   | 1          |           | (34)   |
| (95)m=  | 486.27    | 498.08     | 492.37           | 461.46     | 387.11        | 265.09     | 178.5        | 186.54        | 288.05       | 408.11     | 452.94                 | 471.35     |           | (95)   |
|         |           | age exte   |                  |            |               |            |              | 100.04        | 200.00       | 400.11     | 402.04                 | 471.00     |           | (00)   |
| (96)m=  | 4.3       | 4.9        | 6.5              | 8.9        | 11.7          | 14.6       | 16.6         | 16.4          | 14.1         | 10.6       | 7.1                    | 4.2        |           | (96)   |
|         | loss rate | e for mea  | an interr        | al tempo   | i<br>erature, | L<br>Lm,W: | I<br>=[(39)m | ı<br>x [(93)m | L<br>– (96)m | 1          |                        |            | l         |        |
| (97)m=  | 729.42    | 702.46     | 632.32           | 520.34     | 397.84        | 265.41     | 178.51       | 186.55        | 289.15       | 444.77     | 596.39                 | 723.06     |           | (97)   |
| Space   | e heatin  | g require  | ement fo         | r each n   | nonth, k      | Wh/mon     | th = 0.02    | 24 x [(97     | )m – (95     | )m] x (4   | 1)m                    |            | 1         |        |
| (98)m=  | 180.9     | 137.35     | 104.12           | 42.39      | 7.99          | 0          | 0            | 0             | 0            | 27.28      | 103.29                 | 187.28     |           |        |
|         |           |            |                  |            | -             | -          | -            | Tota          | l per year   | (kWh/yeai  | <sup>.</sup> ) = Sum(9 | 8)15,912 = | 790.59    | (98)   |
| Space   | e heatin  | g require  | ement in         | kWh/m²     | ²/year        |            |              |               |              |            |                        |            | 8.54      | (99)   |
| 9h En   | erav rea  | quiremer   | nts – Coi        | mmunitv    | heating       | scheme     | ć            |               |              |            |                        |            |           |        |
|         |           |            |                  |            |               |            |              | ting prov     | ided by      | a comm     | unitv sch              | neme.      |           |        |
|         |           |            |                  |            |               |            |              | (Table 1      |              |            | · · <b>,</b> · · ·     |            | 0         | (301)  |
| Fractio | n of spa  | ace heat   | from co          | mmunity    | v system      | 1 – (30    | 1) =         |               |              |            |                        |            | 1         | (302)  |
|         | -         | -          |                  |            |               |            |              | allows for    |              | up to four | other heat             | sources; t | he latter |        |
|         |           | at from C  | -                |            |               | rom powe   | r stations.  | See Appel     | naix C.      |            |                        |            | 1         | (303a) |
| Fractio | n of tota | al space   | heat fro         | m Comr     | nunity h      | eat pum    | р            |               |              | (3         | 02) x (303             | a) =       | 1         | (304a) |
| Factor  | for cont  | trol and o | charging         | method     | l (Table      | 4c(3)) fo  | or commu     | unity hea     | ating sys    | tem        |                        |            | 1         | (305)  |
| Distrib | ution los | ss factor  | (Table 1         | 12c) for a | commun        | ity heati  | ng syste     | m             |              |            |                        |            | 1         | (306)  |
| Space   | heating   | g          |                  |            |               |            |              |               |              |            |                        |            | kWh/ye    | ear    |
| Annua   | l space   | heating    | requiren         | nent       |               |            |              |               |              |            |                        |            | 790.59    |        |
|         |           |            |                  |            |               |            |              |               |              |            |                        |            |           |        |

| Space heat from Community heat pump   | (98) x (304a) x       | (305) x (306) =   | 790.59                     | (307a)     |
|---|-----------------------|---|----------------------------|------------|
| Efficiency of secondary/supplementary heating system in % (from   | Table 4a or Apper     | ndix E)   | 0                          | (308       |
| Space heating requirement from secondary/supplementary system   | (98) x (301) x 1      | 100 ÷ (308) =   | 0                          | (309)      |
| Water heating<br>Annual water heating requirement   |                       |   | 2160.16                    | 7          |
| If DHW from community scheme:<br>Water heat from Community heat pump  | (64) x (303a) x       | (305) x (306) =   | 2160.16                    | (310a)     |
| Electricity used for heat distribution  | 0.01 × [(307a)(307    | 7e) + (310a)(310e)] =                                     | 29.51                      | (313)      |
| Cooling System Energy Efficiency Ratio  |                       |   | 0                          | (314)      |
| Space cooling (if there is a fixed cooling system, if not enter 0)  | = (107) ÷ (314)       | ) =   | 0                          | (315)      |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from ou | tside                 |   | 194.17                     | (330a)     |
| warm air heating system fans  |                       |   | 0                          | (330b)     |
| pump for solar water heating  |                       |   | 0                          | (330g)     |
| Total electricity for the above, kWh/year   | =(330a) + (330        | b) + (330g) =   | 194.17                     | (331)      |
| Energy for lighting (calculated in Appendix L)  |                       |   | 537.95                     | (332)      |
| Electricity generated by PVs (Appendix M) (negative quantity)   |                       |   | -664.99                    | (333)      |
| Electricity generated by wind turbine (Appendix M) (negative quant  | tity)                 |   | 0                          | (334)      |
| 12b. CO2 Emissions – Community heating scheme   |                       |   |                            |            |
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%)                                  | Energy<br>kWh/year    | Emission factor<br>kg CO2/kWh<br>(366) for the second fue | kg CO <mark>2/yea</mark> r | (367a)     |
|   | 0b)] x 100 ÷ (367b) x | 0.52  | = 420.72                   | (367)      |
| Electrical energy for heat distribution [(31  | 3) x                  | 0.52  | = 15.31                    | (372)      |
| Total CO2 associated with community systems (36   | 3)(366) + (368)(37    | <br>2) <sup>=</sup>                                       | = 436.04                   | <br>](373) |
| CO2 associated with space heating (secondary) (30   | 9) x                  | 0   | = 0                        | (374)      |
| CO2 associated with water from immersion heater or instantaneou   | s heater (312) x      | 0.52  | = 0                        | (375)      |
| Total CO2 associated with space and water heating (37   | 3) + (374) + (375) =  |   | 436.04                     | (376)      |
| CO2 associated with electricity for pumps and fans within dwelling  | (331)) x              | 0.52  | = 100.77                   | (378)      |
| CO2 associated with electricity for lighting (33  | 2))) x                | 0.52  | = 279.2                    | (379)      |
| Energy saving/generation technologies (333) to (334) as applicable Item 1   | e                     | 0.52 × 0.01 =   | -345.13                    | (380)      |
| Total CO2, kg/year sum of (376)(382) =  |                       |   | 470.88                     | (383)      |
| Dwelling CO2 Emission Rate (383) ÷ (4) =  |                       |   | 5.09                       | (384)      |
| El rating (section 14)  |                       |   | 95.41                      | (385)      |

|   |   | ι                 | User De   | etails:          |                |             |                       |              |                              |              |
|---|---|-------------------|-----------|------------------|----------------|-------------|-----------------------|--------------|------------------------------|--------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 2012  |                   | ;         | Stroma<br>Softwa | re Ver         |             |                       | Versio       | n: 1.0.4.23                  |              |
|   | 2 Bed Flat, 219-223                                     |                   |           | Address:         |                | nh lunat    | ion I ON              |              |                              |              |
| Address :<br>1. Overall dwelling dimer  |   | Columato          | our Lar   | ne, Loug         | προιοαί        | in Junci    | ION, LOP              | NDON         |                              |              |
| Ground floor  |   |                   | Area      |                  | (1a) x         | Av. Hei     | <b>ight(m)</b><br>2.5 | (2a) =       | Volume(m <sup>3</sup><br>192 | )<br>(3a)    |
| Total floor area TFA = (1a  | a)+(1b)+(1c)+(1d)+(1e)                                  | )+(1n)            | 7         | 6.8              | (4)            |             |                       |              |                              |              |
| Dwelling volume   |   |                   |           |                  | (3a)+(3b)      | +(3c)+(3d   | l)+(3e)+              | .(3n) =      | 192                          | (5)          |
| 2. Ventilation rate:  |   |                   |           |                  |                |             |                       |              |                              |              |
|   | heating h   | condary<br>eating |           | other            | , r            | total       |                       |              | m <sup>3</sup> per hou       | _            |
| Number of chimneys  | 0 +   | 0                 | +         | 0                | ] = [<br>] = [ | 0           |                       | 40 =<br>20 = | 0                            | (6a)         |
| Number of open flues<br>Number of intermittent far                                    |   | 0                 |           | 0                |                | 0           |                       | 0 =<br>10 =  | 0                            | (6b)<br>(7a) |
| Number of passive vents   |   |                   |           |                  |                | 0           |                       | 0 =          | 0                            | (7a)         |
| Number of flueless gas fir  | es  |                   |           |                  |                | 0           |                       | 40 =         | 0                            | (70)         |
|   |   |                   |           |                  | L              | 0           |                       | Air ch       | anges per ho                 |              |
| Infiltration due to chimney   |   |                   |           |                  |                | 0           |                       | ÷ (5) =      | 0                            | (8)          |
| If a pressurisation test has be<br>Number of storeys in th<br>Additional infiltration | e dwelling (ns)   |                   |           |                  |                |             |                       | 1]x0.1 =     | 0                            | (9)<br>(10)  |
| deducting areas of opening  | esent, use the value corresp<br>gs); if equal user 0.35 | oonding to th     | he greate | er wall area     | a (after       | uction      |                       |              | 0                            | (11)         |
| If suspended wooden fl  |   | ed) or 0.1        | (seale    | d), else         | enter 0        |             |                       |              | 0                            | (12)         |
| If no draught lobby, ent  |   |                   |           |                  |                |             |                       |              | 0                            | (13)         |
| Percentage of windows<br>Window infiltration  | and doors draught str                                   | прреа             | (         | 0.25 - [0.2      | x (14) ÷ 1     | 001 -       |                       |              | 0                            | (14)         |
| Infiltration rate   |   |                   |           | (8) + (10) -     |                |             | + (15) =              |              | 0                            | (15)<br>(16) |
| Air permeability value, o   | a50. expressed in cubi                                  | ic metres         |           |                  |                |             |                       | area         | 2                            | (17)         |
| If based on air permeabilit   |   |                   | •         | •                | •              |             |                       |              | 0.1                          | (18)         |
| Air permeability value applies  | -   |                   |           |                  |                | is being us | sed                   | I            | -                            |              |
| Number of sides sheltered   | b   |                   |           |                  |                |             |                       |              | 1                            | (19)         |
| Shelter factor  |   |                   |           | (20) = 1 - [     |                | 9)] =       |                       |              | 0.92                         | (20)         |
| Infiltration rate incorporati   | -   |                   | (         | (21) = (18)      | x (20) =       |             |                       |              | 0.09                         | (21)         |
| Infiltration rate modified for  |   | i                 |           |                  |                | _           |                       |              |                              |              |
| Jan Feb   | Mar Apr May   | Jun               | Jul       | Aug              | Sep            | Oct         | Nov                   | Dec          |                              |              |
| Monthly average wind spe  |   |                   |           | I                |                |             |                       | <b>1</b>     |                              |              |
| (22)m= 5.1 5  | 4.9 4.4 4.3   | 3.8               | 3.8       | 3.7              | 4              | 4.3         | 4.5                   | 4.7          |                              |              |
| Wind Factor (22a)m = (22  | · · · · ·   |                   | ,         |                  |                |             | 1                     |              |                              |              |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08  | 0.95              | 0.95      | 0.92             | 1              | 1.08        | 1.12                  | 1.18         |                              |              |

| Adjuste   | ed infiltr             | ation rat                      | e (allow       | ing for sh                  | nelter an    | d wind s        | peed) =         | (21a) x                               | (22a)m       |               |                       |                    |                  |               |
|-----------|------------------------|--------------------------------|----------------|-----------------------------|--------------|-----------------|-----------------|---------------------------------------|--------------|---------------|-----------------------|--------------------|------------------|---------------|
|           | 0.12                   | 0.12                           | 0.11           | 0.1                         | 0.1          | 0.09            | 0.09            | 0.09                                  | 0.09         | 0.1           | 0.1                   | 0.11               | ]                |               |
|           |                        | <i>ctive air</i><br>al ventila | -              | rate for t                  | he appli     | cable ca        | se              |                                       |              |               |                       |                    |                  | (23a)         |
|           |                        |                                |                | endix N, (2                 | (23a) = (23a | a) x Fmv (e     | equation (I     | N5)), othe                            | rwise (23b   | (23a) = (23a) |                       |                    | 0.5              |               |
|           |                        |                                |                | ciency in %                 |              |                 |                 |                                       |              | <i>(</i> 200) |                       |                    | 0.5              | (23b)         |
|           |                        |                                | -              | -                           | -            |                 |                 |                                       |              | 2b)m + (2     | 23h) v [ <sup>,</sup> | 1 _ (23c)          | 73.1<br>÷ 1001   | (23c)         |
| (24a)m=   | 0.25                   | 0.25                           | 0.25           | 0.24                        | 0.23         | 0.22            | 0.22            | 0.22                                  | 0.23         | 0.23          | 0.24                  | 0.24               | ]                | (24a)         |
|           |                        |                                |                |                             |              |                 |                 |                                       |              | 2b)m + (2     | -                     | •                  | ]                | · · ·         |
| (24b)m=   | 0                      |                                |                | 0                           | 0            | 0               |                 |                                       | 0            | 0             | 0                     | 0                  | ן                | (24b)         |
|           | u<br>whole h           | I<br>Iouse ex                  | I<br>tract ver | ntilation of                | r positiv    | l<br>ve input v | l<br>ventilatio | n from o                              | L<br>outside |               |                       |                    | J                |               |
| ,         |                        |                                |                |                             | •            | •               |                 |                                       |              | .5 × (23b     | )                     |                    |                  |               |
| (24c)m=   | 0                      | 0                              | 0              | 0                           | 0            | 0               | 0               | 0                                     | 0            | 0             | 0                     | 0                  |                  | (24c)         |
| ,         |                        |                                |                | ole hous                    | •            |                 |                 |                                       |              | -             |                       | -                  | -                |               |
| 1         | · ,                    | r                              | r í j          | )m = (22l                   | ŕ            | r Ì             | ,<br>           | 1                                     | r            |               |                       | -                  | 1                |               |
| (24d)m=   |                        | 0                              | 0              | 0                           | 0            | 0               | 0               | 0                                     | 0            | 0             | 0                     | 0                  |                  | (24d)         |
| 1         |                        | <u> </u>                       |                | nter (24a                   | , <u>,</u>   | <u> </u>        | , <u>,</u>      | · · · · · · · · · · · · · · · · · · · | <u> </u>     |               |                       | i                  | 1                | ( )           |
| (25)m=    | 0.25                   | 0.25                           | 0.25           | 0.24                        | 0.23         | 0.22            | 0.22            | 0.22                                  | 0.23         | 0.23          | 0.24                  | 0.24               |                  | (25)          |
| 3. He     | at l <mark>osse</mark> | s and he                       | eat loss       | paramete                    | er:          |                 |                 |                                       |              |               |                       |                    |                  |               |
| ELEN      |                        | Gros<br>are <mark>a</mark>     |                | Openin<br>m                 |              | Net Ar<br>A ,r  |                 | U-val<br>W/m2                         |              | A X U<br>(W/ł | <)                    | k-value<br>kJ/m²·l |                  | A X k<br>kJ/K |
| Windov    | ws Type                | e 1                            |                |                             |              | 2.7             | x1/             | /[1/( 0.73 )-                         | + 0.04] =    | 1.92          |                       |                    |                  | (27)          |
| Windov    | ws Type                | ∋2                             |                |                             |              | 3.6             | x1/             | /[1/( 0.73 )-                         | + 0.04] =    | 2.55          |                       |                    |                  | (27)          |
| Windov    | ws Type                | e 3                            |                |                             |              | 7.2             | ×1/             | /[1/( 0.73 )-                         | + 0.04] =    | 5.11          | F.                    |                    |                  | (27)          |
| Window    | ws Type                | e 4                            |                |                             |              | 4.94            | x1/             | /[1/( 0.73 )-                         | + 0.04] =    | 3.5           | 5                     |                    |                  | (27)          |
| Walls 1   | Гуре1                  | 5                              |                | 2.7                         |              | 2.3             | x               | 0.15                                  | =            | 0.35          |                       |                    |                  | (29)          |
| Walls 7   | Гуре2                  | 31.                            | 5              | 3.6                         |              | 27.9            | x               | 0.15                                  | = [          | 4.19          | ז ד                   |                    | $\exists \vdash$ | (29)          |
| Walls 7   | ГуреЗ                  | 22.7                           | 75             | 7.2                         |              | 15.55           | 5 X             | 0.15                                  |              | 2.33          | ז ד                   |                    | $\exists \vdash$ | (29)          |
| Walls 7   | Гуре4                  | 15                             | ;              | 4.94                        |              | 10.06           | 3 X             | 0.15                                  |              | 1.51          | ז ר                   |                    | = =              | (29)          |
| Total a   | rea of e               | elements                       | , m²           |                             |              | 74.25           | 5               | μ                                     |              |               |                       |                    |                  | (31)          |
| Party v   | vall                   |                                |                |                             |              | 37.5            | x               | 0                                     | =            | 0             |                       |                    |                  | (32)          |
| Party f   | loor                   |                                |                |                             |              | 76.8            |                 |                                       | I            |               | L                     |                    | $\dashv$         | (32a)         |
| Party c   | eiling                 |                                |                |                             |              | 76.8            |                 |                                       |              |               | L<br>L                |                    | $\dashv$         | (32b)         |
| -         | ul wall **             |                                |                |                             |              | 117             |                 |                                       |              |               | L<br>L                |                    | $\dashv$         | (32c)         |
| * for win | dows and               | l roof wind                    |                | effective wi<br>nternal wal |              | alue calcul     | ated using      | g formula 1                           | !/[(1/U-valı | ıe)+0.04] a   | L<br>s given in       | paragraph          | L<br>1 3.2       | (1 - 7        |
|           |                        | ss, W/K :                      |                |                             |              |                 |                 | (26)(30)                              | ) + (32) =   |               |                       |                    | 21.45            | (33)          |
|           |                        | Cm = S(                        | •              | -                           |              |                 |                 |                                       | ((28)        | (30) + (32    | 2) + (32a).           | (32e) =            | 16870.           |               |

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

250

Indicative Value: Medium

(35)

|           |                      | 00          | are not kr  | 10wn (36) =                | = 0.05 x (3    | :1)         |            |             |              |                    |                                       |         |                       | _          |
|-----------|----------------------|-------------|-------------|----------------------------|----------------|-------------|------------|-------------|--------------|--------------------|---------------------------------------|---------|-----------------------|------------|
| Total f   | fabric he            | at loss     |             |                            |                |             |            |             | (33) +       | (36) =             |                                       |         | 29.44                 | (37)       |
| Ventila   | ation hea            | at loss c   | alculated   | d monthly                  | y              |             |            |             | (38)m        | = 0.33 × (         | 25)m x (5)                            |         | •                     |            |
|           | Jan                  | Feb         | Mar         | Apr                        | May            | Jun         | Jul        | Aug         | Sep          | Oct                | Nov                                   | Dec     |                       |            |
| (38)m=    | 15.99                | 15.85       | 15.7        | 14.97                      | 14.82          | 14.09       | 14.09      | 13.94       | 14.38        | 14.82              | 15.12                                 | 15.41   |                       | (38)       |
| Heat t    | ransfer o            | coefficie   | nt, W/K     |                            |                |             |            |             | (39)m        | = (37) + (         | 38)m                                  |         |                       |            |
| (39)m=    | 45.44                | 45.29       | 45.15       | 44.41                      | 44.27          | 43.53       | 43.53      | 43.39       | 43.83        | 44.27              | 44.56                                 | 44.85   |                       |            |
|           |                      | •           |             | 1                          |                | •           |            | 1           |              | Average =          | Sum(39)1                              | 12 /12= | 44.38                 | (39)       |
| Heat I    | oss para             | ameter (H   | HLP), W     | /m²K                       |                |             |            |             | (40)m        | = (39)m ÷          | · (4)                                 |         | 1                     |            |
| (40)m=    | 0.59                 | 0.59        | 0.59        | 0.58                       | 0.58           | 0.57        | 0.57       | 0.56        | 0.57         | 0.58               | 0.58                                  | 0.58    |                       | _          |
| Numb      | er of day            | ys in mo    | nth (Tab    | ole 1a)                    |                |             |            |             |              | Average =          | Sum(40)1                              | 12 /12= | 0.58                  | (40)       |
|           | Jan                  | Feb         | Mar         | Apr                        | May            | Jun         | Jul        | Aug         | Sep          | Oct                | Nov                                   | Dec     |                       |            |
| (41)m=    | 31                   | 28          | 31          | 30                         | 31             | 30          | 31         | 31          | 30           | 31                 | 30                                    | 31      |                       | (41)       |
|           |                      |             | •           |                            |                |             |            |             |              |                    |                                       |         | •                     |            |
| 4. W      | ater hea             | tina ene    | rav reau    | irement:                   |                |             |            |             |              |                    |                                       | kWh/y   | ear:                  |            |
|           |                      | Ŭ           |             |                            |                |             |            |             |              |                    |                                       |         | -                     |            |
|           | ned occu             |             |             | ([1 oyn                    | ( 0 0003       | 240 v /TE   | = 120      | )2)] + 0.0  | 1012 v (     | TEA 12             |                                       | .4      | J                     | (42)       |
|           | FA £ 13.             |             | + 1.70 /    | (li-exp                    | (-0.000        | 043 X (11   | A-13.5     | ()2)] + 0.0 | 5015 X (     | II A - 13.         | .9)                                   |         |                       |            |
|           |                      |             |             |                            |                |             |            | (25 x N)    |              |                    |                                       | .18     |                       | (43)       |
|           |                      | -           |             | usage by .<br>r day (all w |                | -           | -          | to achieve  | a water us   | se target o        | f                                     |         |                       |            |
| ποι πιοι  |                      |             | person pe   | r day (all w               |                | 101 and co  |            |             |              |                    |                                       |         | ,                     |            |
|           | Jan                  | Feb         | Mar         | Apr                        | May            | Jun         |            | Aug         | Sep          | Oct                | Nov                                   | Dec     |                       |            |
|           | _                    |             |             | ach month                  |                |             |            |             |              | _                  |                                       | I       | 1                     |            |
| (44)m=    | 100.3                | 96.66       | 93.01       | 89.36                      | 85.71          | 82.07       | 82.07      | 85.71       | 89.36        | 93.01              | 96.66                                 | 100.3   |                       | <b>-</b> ] |
| Energy    | content of           | f hot water | used - ca   | lculated mo                | onthly $= 4$ . | 190 x Vd,r  | m x nm x D | OTm / 3600  |              |                    | m(44) <sub>112</sub> =<br>ables 1b, 1 |         | 10 <mark>94.21</mark> | (44)       |
| (45)m=    | 148.75               | 130.09      | 134.25      | 117.04                     | 112.3          | 96.91       | 89.8       | 103.05      | 104.28       | 121.52             | 132.65                                | 144.05  |                       |            |
|           |                      |             |             |                            |                |             |            |             |              | Total = Su         | m(45) <sub>112</sub> =                | =       | 1434.68               | (45)       |
| lf instar | ntaneous v           | vater heati | ng at point | t of use (no               | o hot water    | r storage), | enter 0 in | boxes (46   | ) to (61)    |                    |                                       |         | •                     |            |
| (46)m=    |                      | 19.51       | 20.14       | 17.56                      | 16.85          | 14.54       | 13.47      | 15.46       | 15.64        | 18.23              | 19.9                                  | 21.61   |                       | (46)       |
|           | storage              |             | ) includir  |                            | alar ar M      |             | ctorogo    | within sa   |              | col                |                                       | 400     | 1                     | (47)       |
| -         | -                    | . ,         |             | ank in dw                  |                |             | -          |             |              | 301                |                                       | 180     | J                     | (47)       |
|           | •                    | •           |             |                            | •              |             |            | ombi boil   | ers) ente    | ≥r '0' in <i>(</i> | (47)                                  |         |                       |            |
|           | storage              |             | not wat     |                            |                | notantai    |            |             |              |                    |                                       |         |                       |            |
|           | -                    |             | eclared l   | loss facto                 | or is kno      | wn (kWł     | n/day):    |             |              |                    |                                       | 0       | ]                     | (48)       |
| Temp      | erature f            | actor fro   | m Table     | e 2b                       |                |             |            |             |              |                    |                                       | 0       |                       | (49)       |
| Energ     | y lost fro           | om watei    | r storage   | e, kWh/ye                  | ear            |             |            | (48) x (49) | ) =          |                    | 1                                     | 80      |                       | (50)       |
| -         | •                    |             | -           | cylinder l                 |                | or is not   | known:     |             |              |                    | ·                                     |         | 1                     | · · ·      |
|           |                      | -           |             | rom Tabl                   | le 2 (kW       | h/litre/da  | ay)        |             |              |                    | 0.                                    | .01     | ]                     | (51)       |
|           | munity ł             | -           |             | on 4.3                     |                |             |            |             |              |                    |                                       |         | 1                     |            |
|           | ne factor            |             |             | 2h                         |                |             |            |             |              |                    |                                       | 87      | -                     | (52)       |
|           | erature f            |             |             |                            |                |             |            | (           |              | 50)                |                                       | .6      | ]                     | (53)       |
| -         | •                    |             | -           | e, kWh/ye                  | ear            |             |            | (47) x (51) | ) x (52) x ( | 53) =              |                                       | 97      | -                     | (54)       |
| ciller    | <sup>-</sup> (50) or | (34) 111 (3 | 55)         |                            |                |             |            |             |              |                    | 0.                                    | .97     |                       | (55)       |

| Water  | storage  | loss cal  | culated f  | for each  | month   |   |   | ((56)m = (   | 55) × (41)   | m   |                                     |   |                       |                                      |
|--|--|---|--|---|---|---|---|--|--|---|-------------------------------------|---|-----------------------|--------------------------------------|
| (56)m=   | 30.09  | 27.18   | 30.09  | 29.12   | 30.09   | 29.12   | 30.09   | 30.09  | 29.12  | 30.09   | 29.12                               | 30.09   |                       | (56)                                 |
| If cylind  | er contain   | s dedicate  | d solar sto  | rage, (57)  | m = (56)m   | x [(50) – (   | H11)] ÷ (5  | 0), else (5  | 7)m = (56)   | m where (   | H11) is fro                         | m Append                                      | lix H                 |                                      |
| (57)m=   | 30.09  | 27.18   | 30.09  | 29.12   | 30.09   | 29.12   | 30.09   | 30.09  | 29.12  | 30.09   | 29.12                               | 30.09   |                       | (57)                                 |
| Prima  | y circuit  | loss (ar  | nnual) fro   | om Table  | e 3   | -   |   |  |  | -   | -                                   | 0   |                       | (58)                                 |
|  | •  | •   | culated  |   |   | 59)m = (  | (58) ÷ 36   | 65 × (41)  | m  |   |                                     |   |                       |                                      |
| (mo  | dified by  | factor f  | rom Tab  | le H5 if t  | here is s   | solar wat   | er heatii   | ng and a   | cylinde  | r thermo  | stat)                               |   |                       |                                      |
| (59)m=   | 23.26  | 21.01   | 23.26  | 22.51   | 23.26   | 22.51   | 23.26   | 23.26  | 22.51  | 23.26   | 22.51                               | 23.26   |                       | (59)                                 |
| Combi  | loss ca  | lculated  | for each   | month   | (61)m =   | (60) ÷ 36   | 65 × (41)   | )m   |  |   |                                     |   |                       |                                      |
| (61)m=   | 0  | 0   | 0  | 0   | 0   | 0   | 0   | 0  | 0  | 0   | 0                                   | 0   |                       | (61)                                 |
| Total h  | neat req   | uired for   | water h  | eating ca   | alculated   | for eac   | h month   | (62)m =  | 0.85 × (   | (45)m +   | (46)m +                             | (57)m +                                       | (59)m + (61)m         | ı                                    |
| (62)m=   | 202.1  | 178.28  | 187.6  | 168.67  | 165.65  | 148.54  | 143.15  | 156.4  | 155.91   | 174.88  | 184.29                              | 197.41  |                       | (62)                                 |
| Solar DI   | HW input   | calculated  | using App  | endix G o   | r Appendix  | H (negati   | ve quantity   | /) (enter '0   | ' if no sola   | r contribut   | ion to wate                         | er heating)                                   |                       |                                      |
| (add a   | dditiona   | l lines if  | FGHRS  | and/or \  | NWHRS   | applies   | , see Ap  | pendix (   | G)   |   |                                     |   |                       |                                      |
| (63)m=   | 0  | 0   | 0  | 0   | 0   | 0   | 0   | 0  | 0  | 0   | 0                                   | 0   |                       | (63)                                 |
| Output   | t from w   | ater hea  | ter  |   |   |   |   |  |  | -   |                                     |   |                       |                                      |
| (64)m=   | 202.1  | 178.28  | 187.6  | 168.67  | 165.65  | 148.54  | 143.15  | 156.4  | 155.91   | 174.88  | 184.29                              | 197.41  |                       | _                                    |
|  |  |   |  |   |   |   |   | Outp   | out from w   | ater heate  | r (annual)₁                         | 12  | 2062.88               | (64)                                 |
| Hea <mark>t g</mark>   | ains fro   | m water   | heating,   | , kWh/m   | onth 0.2  | 5   | × (45)m   | + (61)n  | n] + 0.8 x   | k [(46)m  | + (57)m                             | + (59)m                                       | ]                     |                                      |
| (65)m=   | <mark>6</mark> 8.07  | 60.07   | 63.25  | 56.92   | 55.95   | 5 <mark>0.23</mark>   | 48.47   | 52.87  | 52.68  | 59.02   | 62.12                               | 66.51   |                       | (65)                                 |
| inclu  | ude (57)   | m in calc   | culation of  | of (65)m  | only if c   | ylinder i   | s in t <mark>he</mark> o  | dwelling   | or hot w   | ate <mark>r is f</mark> r                                   | om com                              | <mark>mu</mark> nity h                        | neating               |                                      |
| 5. In  | ternal ga  | ains (see   | e Table 5  | 5 and 5a  | ):  |   |   |  |  |   |                                     |   |                       |                                      |
| Metab  | olic gair  | s (Table  | e 5), Wat  | ts  |   |   |   | i  |  | _   |                                     |   |                       |                                      |
|  | Jan  | Feb   | Mar  | Apr   | May   | Jun   | Jul   | Aug  | Sep  | Oct   | Nov                                 | Dec   |                       |                                      |
| (66)m=   | 119.97   | 119.97  | 119.97   | 119.97  | 119.97  | 119.97  | 119.97  | 440.07   |  |   | 119.97                              | 119.97  |                       | (00)                                 |
| Lightin  |  |   |  |   |   |   | 110.07  | 119.97   | 119.97   | 119.97  |                                     |   | J                     | (66)                                 |
| (67)m=   | ig gains   | (calcula  | ted in Ap  | pendix  | L, equat  | ion L9 o  |   |  |  | 119.97  |                                     |   | ]                     | (66)                                 |
| · · ·  | 25.99  | <u>`</u>  | · · · ·  | ·   | L, equat  | ion L9 o<br>8.97  |   |  |  | 21.47   | 25.06                               | 26.72   | ]                     | (66)                                 |
|  | 25.99  | 23.09   | · · ·  | 14.21   | 10.63   | 8.97  | r L9a), a<br>9.69   | lso see<br>12.6  | Table 5<br>16.91   | 21.47   | 25.06                               |   | ]                     |                                      |
| Applia   | 25.99  | 23.09<br>ins (calc  | 18.78  | 14.21   | 10.63   | 8.97  | r L9a), a<br>9.69   | lso see<br>12.6  | Table 5<br>16.91   | 21.47   | 25.06<br>189.2                      |   | ]                     |                                      |
| Applia<br>(68)m=   | 25.99<br>nces ga<br>212.62   | 23.09<br>ins (calc<br>214.83  | 18.78<br>ulated in   | 14.21<br>Append<br>197.43   | 10.63<br>dix L, eq<br>182.49  | 8.97<br>uation L<br>168.45  | r L9a), a<br>9.69<br>13 or L1<br>159.07   | lso see<br>12.6<br>3a), also<br>156.86   | Table 5<br>16.91<br>see Ta<br>162.42   | 21.47<br>ble 5<br>174.26                                    |                                     | 26.72   | ]                     | (67)                                 |
| Applia<br>(68)m=   | 25.99<br>nces ga<br>212.62   | 23.09<br>ins (calc<br>214.83  | 18.78<br>ulated ir<br>209.27   | 14.21<br>Append<br>197.43   | 10.63<br>dix L, eq<br>182.49  | 8.97<br>uation L<br>168.45  | r L9a), a<br>9.69<br>13 or L1<br>159.07   | lso see<br>12.6<br>3a), also<br>156.86   | Table 5<br>16.91<br>see Ta<br>162.42   | 21.47<br>ble 5<br>174.26                                    |                                     | 26.72   | ]<br>]<br>]           | (67)                                 |
| Applia<br>(68)m=<br>Cookir<br>(69)m=   | 25.99<br>nces ga<br>212.62<br>ng gains<br>35   | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35  | 18.78<br>culated in<br>209.27<br>ated in A   | 14.21<br>Append<br>197.43<br>ppendix<br>35                                    | 10.63<br>dix L, eq<br>182.49<br>L, equat                                  | 8.97<br>uation L<br>168.45<br>tion L15  | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)                               | lso see<br>12.6<br>3a), also<br>156.86<br>), also se                                   | Table 5<br>16.91<br>see Ta<br>162.42<br>ee Table                                   | 21.47<br>ble 5<br>174.26                                    | 189.2                               | 26.72<br>203.24                               | ]<br>]<br>]           | (67)<br>(68)                         |
| Applia<br>(68)m=<br>Cookir<br>(69)m=   | 25.99<br>nces ga<br>212.62<br>ng gains<br>35   | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35  | 18.78<br>sulated in<br>209.27<br>ated in A<br>35   | 14.21<br>Append<br>197.43<br>ppendix<br>35                                    | 10.63<br>dix L, eq<br>182.49<br>L, equat                                  | 8.97<br>uation L<br>168.45<br>tion L15  | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)                               | lso see<br>12.6<br>3a), also<br>156.86<br>), also se                                   | Table 5<br>16.91<br>see Ta<br>162.42<br>ee Table                                   | 21.47<br>ble 5<br>174.26                                    | 189.2                               | 26.72<br>203.24                               | ]<br>]<br>]           | (67)<br>(68)                         |
| Applia<br>(68)m=<br>Cookir<br>(69)m=<br>Pumps<br>(70)m=  | 25.99<br>nces ga<br>212.62<br>ng gains<br>35<br>s and fat<br>0   | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35<br>ns gains<br>0   | 18.78<br>ulated ir<br>209.27<br>ated in A<br>35<br>(Table 5  | 14.21<br>Append<br>197.43<br>ppendix<br>35<br>5a)<br>0                        | 10.63<br>dix L, eq<br>182.49<br>L, equat<br>35<br>0                       | 8.97<br>uation L<br>168.45<br>tion L15<br>35<br>0                             | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)<br>35                         | lso see<br>12.6<br>3a), also<br>156.86<br>, also se<br>35                              | Table 5<br>16.91<br>see Ta<br>162.42<br>ee Table<br>35                             | 21.47<br>ble 5<br>174.26<br>5<br>35                         | 189.2<br>35                         | 26.72<br>203.24<br>35                         | ]<br>]<br>]           | (67)<br>(68)<br>(69)                 |
| Applia<br>(68)m=<br>Cookir<br>(69)m=<br>Pumps<br>(70)m=  | 25.99<br>nces ga<br>212.62<br>ng gains<br>35<br>s and fat<br>0   | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35<br>ns gains<br>0   | 18.78<br>ulated in<br>209.27<br>ated in A<br>35<br>(Table 5<br>0   | 14.21<br>Append<br>197.43<br>ppendix<br>35<br>5a)<br>0                        | 10.63<br>dix L, eq<br>182.49<br>L, equat<br>35<br>0                       | 8.97<br>uation L<br>168.45<br>tion L15<br>35<br>0                             | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)<br>35                         | lso see<br>12.6<br>3a), also<br>156.86<br>, also se<br>35                              | Table 5<br>16.91<br>see Ta<br>162.42<br>ee Table<br>35                             | 21.47<br>ble 5<br>174.26<br>5<br>35                         | 189.2<br>35                         | 26.72<br>203.24<br>35                         | ]<br>]<br>]<br>]      | (67)<br>(68)<br>(69)                 |
| Applia<br>(68)m=<br>Cookir<br>(69)m=<br>Pumps<br>(70)m=<br>Losses<br>(71)m=                    | 25.99<br>nces ga<br>212.62<br>ng gains<br>35<br>s and fa<br>0<br>s e.g. ev<br>-95.97                     | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35<br>ns gains<br>0<br>vaporatic                                | 18.78<br>209.27<br>ated in A<br>35<br>(Table 5<br>0<br>on (nega<br>-95.97  | 14.21<br>Append<br>197.43<br>ppendix<br>35<br>5a)<br>0<br>tive valu           | 10.63<br>dix L, eq<br>182.49<br>L, equat<br>35<br>0<br>es) (Tab           | 8.97<br>uation L<br>168.45<br>tion L15<br>35<br>0<br>le 5)                    | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)<br>35<br>0                    | lso see<br>12.6<br>3a), also<br>156.86<br>), also se<br>35<br>0                        | Table 5<br>16.91<br>9 see Ta<br>162.42<br>2ee Table<br>35<br>0                     | 21.47<br>ble 5<br>174.26<br>5<br>35<br>0                    | 189.2<br>35<br>0                    | 26.72<br>203.24<br>35<br>0                    | ]<br>]<br>]<br>]      | (67)<br>(68)<br>(69)<br>(70)         |
| Applia<br>(68)m=<br>Cookir<br>(69)m=<br>Pumps<br>(70)m=<br>Losses<br>(71)m=                    | 25.99<br>nces ga<br>212.62<br>ng gains<br>35<br>s and fa<br>0<br>s e.g. ev<br>-95.97                     | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35<br>ns gains<br>0<br>raporatic<br>-95.97                      | 18.78<br>209.27<br>ated in A<br>35<br>(Table 5<br>0<br>on (nega<br>-95.97  | 14.21<br>Append<br>197.43<br>ppendix<br>35<br>5a)<br>0<br>tive valu           | 10.63<br>dix L, eq<br>182.49<br>L, equat<br>35<br>0<br>es) (Tab           | 8.97<br>uation L<br>168.45<br>tion L15<br>35<br>0<br>le 5)                    | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)<br>35<br>0                    | lso see<br>12.6<br>3a), also<br>156.86<br>), also se<br>35<br>0                        | Table 5<br>16.91<br>9 see Ta<br>162.42<br>2ee Table<br>35<br>0                     | 21.47<br>ble 5<br>174.26<br>5<br>35<br>0                    | 189.2<br>35<br>0                    | 26.72<br>203.24<br>35<br>0                    | ]<br>]<br>]<br>]      | (67)<br>(68)<br>(69)<br>(70)         |
| Applia<br>(68)m=<br>Cookir<br>(69)m=<br>Pumps<br>(70)m=<br>Losses<br>(71)m=<br>Water<br>(72)m= | 25.99<br>nces ga<br>212.62<br>ng gains<br>35<br>s and fa<br>0<br>s e.g. ev<br>-95.97<br>heating<br>91.49 | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35<br>ns gains<br>0<br>raporatic<br>-95.97<br>gains (T          | 18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>10.72<br>18.78<br>18.78<br>10.72<br>18.78<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10 | 14.21<br>197.43<br>197.43<br>ppendix<br>35<br>5a)<br>0<br>tive valu<br>-95.97 | 10.63<br>dix L, eq<br>182.49<br>L, equat<br>35<br>0<br>es) (Tab<br>-95.97 | 8.97<br>uation L<br>168.45<br>tion L15<br>35<br>0<br>le 5)<br>-95.97<br>69.77 | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)<br>35<br>0<br>-95.97<br>65.15 | lso see <sup>-</sup><br>12.6<br>3a), also<br>156.86<br>), also se<br>35<br>0<br>-95.97 | Table 5<br>16.91<br>9 see Ta<br>162.42<br>9 ee Table<br>35<br>0<br>-95.97<br>73.17 | 21.47<br>ble 5<br>174.26<br>5<br>35<br>0<br>-95.97<br>79.32 | 189.2<br>35<br>0<br>-95.97<br>86.27 | 26.72<br>203.24<br>35<br>0<br>-95.97<br>89.39 | ]<br>]<br>]<br>]      | (67)<br>(68)<br>(69)<br>(70)<br>(71) |
| Applia<br>(68)m=<br>Cookir<br>(69)m=<br>Pumps<br>(70)m=<br>Losses<br>(71)m=<br>Water<br>(72)m= | 25.99<br>nces ga<br>212.62<br>ng gains<br>35<br>s and fa<br>0<br>s e.g. ev<br>-95.97<br>heating<br>91.49 | 23.09<br>ins (calc<br>214.83<br>(calcula<br>35<br>ns gains<br>0<br>vaporatic<br>-95.97<br>gains (T<br>89.38 | 18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>18.78<br>10.72<br>18.78<br>18.78<br>10.72<br>18.78<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10.72<br>10 | 14.21<br>197.43<br>197.43<br>ppendix<br>35<br>5a)<br>0<br>tive valu<br>-95.97 | 10.63<br>dix L, eq<br>182.49<br>L, equat<br>35<br>0<br>es) (Tab<br>-95.97 | 8.97<br>uation L<br>168.45<br>tion L15<br>35<br>0<br>le 5)<br>-95.97<br>69.77 | r L9a), a<br>9.69<br>13 or L1<br>159.07<br>or L15a)<br>35<br>0<br>-95.97<br>65.15 | lso see<br>12.6<br>3a), also<br>156.86<br>), also se<br>35<br>0<br>-95.97<br>71.07     | Table 5<br>16.91<br>9 see Ta<br>162.42<br>9 ee Table<br>35<br>0<br>-95.97<br>73.17 | 21.47<br>ble 5<br>174.26<br>5<br>35<br>0<br>-95.97<br>79.32 | 189.2<br>35<br>0<br>-95.97<br>86.27 | 26.72<br>203.24<br>35<br>0<br>-95.97<br>89.39 | ]<br>]<br>]<br>]<br>] | (67)<br>(68)<br>(69)<br>(70)<br>(71) |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: Access Factor<br>Table 6d |   | Area<br>m² |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x 0.77                    | x | 3.6        | x | 11.28            | x | 0.63           | x | 0.1            | = | 1.77         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 22.97            | x | 0.63           | x | 0.1            | = | 3.61         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 41.38            | x | 0.63           | x | 0.1            | = | 6.5          | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 67.96            | x | 0.63           | x | 0.1            | = | 10.68        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 91.35            | x | 0.63           | x | 0.1            | = | 14.36        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 97.38            | x | 0.63           | x | 0.1            | = | 15.31        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 91.1             | x | 0.63           | x | 0.1            | = | 14.32        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 72.63            | x | 0.63           | x | 0.1            | = | 11.41        | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 50.42            | x | 0.63           | x | 0.1            | = | 7.92         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 28.07            | x | 0.63           | x | 0.1            | = | 4.41         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 14.2             | x | 0.63           | x | 0.1            | = | 2.23         | (75) |
| Northeast 0.9x 0.77                    | x | 3.6        | x | 9.21             | x | 0.63           | x | 0.1            | = | 1.45         | (75) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 36.79            |   | 0.63           | x | 0.1            | = | 4.34         | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 62.67            |   | 0.63           | x | 0.1            | = | 7.39         | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 85.75            |   | 0.63           | x | 0.1            | = | 10.11        | (79) |
| Southwest0.9x 0.77                     | x | 2.7        | × | 106.25           |   | 0.63           | х | 0.1            | = | 12.52        | (79) |
| Southwest <mark>0.9x</mark> 0.77       | x | 2.7        | x | 119.01           |   | 0.63           | x | 0.1            | = | 14.03        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 118.15           |   | 0.63           | x | 0.1            | = | 13.93        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 113.91           |   | 0.63           | x | 0.1            | = | 13.43        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 104.39           |   | 0.63           | x | 0.1            | = | 12.31        | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 92.85            |   | 0.63           | x | 0.1            | = | 10.95        | (79) |
| Southwest0.9x 0.77                     | x | 2.7        | x | 69.27            |   | 0.63           | x | 0.1            | = | 8.17         | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 44.07            |   | 0.63           | x | 0.1            | = | 5.2          | (79) |
| Southwest <sub>0.9x</sub> 0.77         | x | 2.7        | x | 31.49            |   | 0.63           | x | 0.1            | = | 3.71         | (79) |
| West 0.9x 0.77                         | x | 4.94       | x | 19.64            | x | 0.63           | x | 0.1            | = | 4.24         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 38.42            | x | 0.63           | x | 0.1            | = | 8.29         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 63.27            | x | 0.63           | x | 0.1            | = | 13.65        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 92.28            | x | 0.63           | x | 0.1            | = | 19.9         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 113.09           | x | 0.63           | x | 0.1            | = | 24.39        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 115.77           | x | 0.63           | x | 0.1            | = | 24.97        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 110.22           | x | 0.63           | x | 0.1            | = | 23.77        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 94.68            | x | 0.63           | x | 0.1            | = | 20.42        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 73.59            | x | 0.63           | x | 0.1            | = | 15.87        | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 45.59            | x | 0.63           | x | 0.1            | = | 9.83         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 24.49            | x | 0.63           | x | 0.1            | = | 5.28         | (80) |
| West 0.9x 0.77                         | x | 4.94       | x | 16.15            | x | 0.63           | x | 0.1            | = | 3.48         | (80) |
| Northwest 0.9x 0.77                    | x | 7.2        | x | 11.28            | x | 0.63           | x | 0.1            | = | 3.55         | (81) |
| Northwest 0.9x 0.77                    | x | 7.2        | x | 22.97            | x | 0.63           | x | 0.1            | = | 7.22         | (81) |
| Northwest 0.9x 0.77                    | x | 7.2        | x | 41.38            | x | 0.63           | x | 0.1            | = | 13.01        | (81) |

|  |          |                         | -        |                 |           |   |              |            |             |           |       | _    |
|--|----------|-------------------------|----------|-----------------|-----------|---|--------------|------------|-------------|-----------|-------|------|
| Northwest 0.9x 0.77                                    | X        | 7.2                     | X        | 6               | 57.96     | ×   | 0.63         | ×          | 0.1         | =         | 21.36 | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | x        | g               | 1.35      | ×   | 0.63         | ×          | 0.1         | =         | 28.71 | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | x        | g               | 7.38      | ×   | 0.63         | x          | 0.1         | =         | 30.61 | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | x        | 9               | 91.1      | <b>x</b> [                                    | 0.63         | x          | 0.1         | =         | 28.64 | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | x        | 7               | 2.63      | <b>x</b>                                      | 0.63         | x          | 0.1         | =         | 22.83 | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | x        | 5               | 0.42      | x   | 0.63         | x          | 0.1         | =         | 15.85 | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | ×        | 2               | 8.07      | ] x [   | 0.63         | x          | 0.1         | =         | 8.82  | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | x        |                 | 14.2      | <b>x</b> [                                    | 0.63         | x [        | 0.1         | =         | 4.46  | (81) |
| Northwest 0.9x 0.77                                    | x        | 7.2                     | x        |                 | 9.21      | <b>x</b> [                                    | 0.63         | x          | 0.1         | =         | 2.9   | (81) |
|  |          |                         |          |                 |           |   |              |            |             |           |       |      |
| Solar gains in watts, calcula                          | ted      | for each mor            | ith      |                 |           | (83)m   | = Sum(74)m   | (82)m      |             |           |       |      |
| (83)m= 13.89 26.5 43.2                                 | 7        | 64.47 81.49             | 9        | 84.81           | 80.15     | 66.9  | 97 50.59     | 31.23      | 17.17       | 11.54     |       | (83) |
| Total gains - internal and so                          | blar     | (84)m = (73)r           | n + (    | (83)m           | , watts   |   |              |            |             |           |       |      |
| (84)m= 402.99 412.79 415.                              | 31       | 414.17 408.8            | 3 3      | 390.99          | 373.05    | 366.  | 48 362.08    | 365.27     | 376.69      | 389.88    |       | (84) |
| 7. Mean internal temperatu                             | ire (    | (heating seas           | on)      |                 |           |   |              |            |             |           |       |      |
| Temperature during heatin                              | g p      | eriods in the I         | iving    | area            | from Tak  | ole 9,  | Th1 (°C)     |            |             |           | 21    | (85) |
| Utilisation factor for gains f                         | or li    | iving area, h1          | ,m (s    | see Ta          | ble 9a)   |   |              |            |             |           |       |      |
| Jan Feb Ma   | ar       | Apr Ma                  | y        | Jun             | Jul       | Αι  | ug Sep       | Oct        | Nov         | Dec       |       |      |
| (86)m= 1 1 0.9   | э        | 0.98 0.9                |          | 0.7             | 0.51      | 0.5   | 4 0.8        | 0.97       | 1           | 1         |       | (86) |
| Mean internal temperature                              | in I     | iving area T1           | (follo   | ow ste          | ps 3 to 7 | 7 in T  | able 9c)     |            |             |           |       |      |
| (87)m= 20.51 20.57 20.6                                | -        | 20.82 20.94             | <u>`</u> | 20.99           | 21        | 21  | · · · ·      | 20.86      | 20.67       | 20.5      |       | (87) |
| Temperature during heatin                              |          | oriode in rest          | of du    | volling         | from To   |   | Th2 (PC)     | 1          |             |           |       |      |
| (88)m= 20.44 20.44 20.4                                |          | 20.45 20.4 <sup>4</sup> |          | 20.46           | 20.46     | 20.4  |              | 20.45      | 20.45       | 20.44     |       | (88) |
|  | -        |                         |          |                 |           |   |              |            |             |           |       |      |
| Utilisation factor for gains f<br>( $(89)$ m= 1 1 0.99 | _        | 1                       |          | 2,m (se<br>0.65 | 0.45      | <u>,                                     </u> | 0 0 75       | 0.00       | 0.00        |           |       | (89) |
| (89)m= 1 1 0.99  | 9        | 0.97 0.87               |          | 0.05            | 0.45      | 0.4   | 8 0.75       | 0.96       | 0.99        | 1         |       | (89) |
| Mean internal temperature                              | _        | 1                       |          |                 | i         | eps 3   | to 7 in Tab  | <u>,</u>   |             |           | I     |      |
| (90)m= 19.78 19.86 20.0                                | )1       | 20.23 20.39             | 9        | 20.46           | 20.46     | 20.4  |              | 20.28      | 20.01       | 19.77     |       | (90) |
|  |          |                         |          |                 |           |   | 1            | fLA = Livi | ng area ÷ ( | 4) =      | 0.34  | (91) |
| Mean internal temperature                              | (fo      | r the whole du          | vellir   | ng) = fl        | LA × T1   | + (1 -  | – fLA) × T2  |            |             |           |       |      |
| (92)m= 20.03 20.1 20.2                                 | :3       | 20.43 20.58             | 3        | 20.64           | 20.64     | 20.6  | 65 20.63     | 20.48      | 20.23       | 20.02     |       | (92) |
| Apply adjustment to the me                             | ean      | internal temp           | erat     | ure fro         | m Table   | e 4e, v                                       | where appro  | opriate    |             |           |       |      |
| (93)m= 20.03 20.1 20.2                                 | 3        | 20.43 20.58             | 3        | 20.64           | 20.64     | 20.6  | 65 20.63     | 20.48      | 20.23       | 20.02     |       | (93) |
| 8. Space heating requirem                              |          |                         |          |                 |           |   |              |            |             |           |       |      |
| Set Ti to the mean internal                            |          | •                       |          | d at ste        | ep 11 of  | Table   | e 9b, so tha | t Ti,m=    | (76)m an    | d re-calc | ulate |      |
| the utilisation factor for gai                         | - 1      |                         |          | lun             | Jul       | ۸.  | ıg Sep       | Oct        | Nov         | Dee       |       |      |
| Jan Feb Ma<br>Utilisation factor for gains,            |          | Apr Ma                  | У        | Jun             | Jui       | Αι  | ig Sep       | Oct        | Nov         | Dec       |       |      |
| $(94)m = \begin{bmatrix} 1 & 1 & 0.99 \end{bmatrix}$   | -        | 0.97 0.88               |          | 0.67            | 0.47      | 0.5   | 5 0.77       | 0.96       | 0.99        | 1         |       | (94) |
| Useful gains, hmGm , W =                               |          |                         |          |                 | ••••      |   |              |            |             |           |       |      |
| (95)m= 401.87 410.99 411.                              | <u> </u> | 400.85 360.4            | 7 2      | 260.67          | 175.98    | 184.  | 04 278.4     | 351.1      | 374.09      | 389.04    |       | (95) |
| Monthly average external t                             | em       | perature from           | Tab      | le 8            | 1         | I   |              | 1          | 1           | 1         | I     |      |
| (96)m= 4.3 4.9 6.5                                     |          | 8.9 11.7                | 1        | 14.6            | 16.6      | 16.   | 4 14.1       | 10.6       | 7.1         | 4.2       |       | (96) |
| Heat loss rate for mean int                            | erna     | al temperatur           | e, Ln    | n , W =         | =[(39)m   | x [(93  | 3)m– (96)m   | ]          |             |           |       |      |
| (97)m= 714.73 688.41 620.                              | 02       | 512.02 393.0            | 8 2      | 262.98          | 176.08    | 184.  | 21 286.14    | 437.25     | 585.2       | 709.52    |       | (97) |
|  |          |                         |          |                 |           |   |              |            |             |           |       |      |

| Space<br>(98)m=     | e heatin<br>232.77         | g require<br>186.43 | ement fo<br>155.27    | or each n<br>80.04      | 10nth, k | Wh/mon      | th = 0.02      | 24 x [(97  | ')m – (95<br>0  | 5)m] x (4  | 1)m<br>152         | 238.43     | ]                         |        |
|---------------------|----------------------------|---------------------|-----------------------|-------------------------|----------|-------------|----------------|------------|-----------------|------------|--------------------|------------|---------------------------|--------|
| (50)11-             | 202.11                     | 100.43              | 100.27                | 00.04                   | 27.21    |             |                | , î        | al per year     | _          |                    |            | 1133.31                   | (98)   |
| Space               | e heatin                   | g require           | ement in              | kWh/m²                  | /year    |             |                |            |                 |            |                    |            | 14.76                     | (99)   |
| 9b. En              | ergy rec                   | luiremer            | nts – Cor             | mmunity                 | heating  | scheme      | e              |            |                 |            |                    |            |                           |        |
|                     |                            |                     |                       |                         |          |             | ater heat      |            |                 |            | unity sc           | heme.      |                           |        |
|                     | -                          |                     |                       | mmunity                 |          | -           | heating (      |            | 1) 0 11 11      | one        |                    |            | 0                         | (301)  |
|                     |                            |                     |                       |                         |          | · ·         | ,              | allows for | CUP and         | un to four | othor hoo          | sources; t | 1                         | (302)  |
|                     |                            | •                   | •                     |                         |          |             | r stations.    |            |                 | up 10 10ui | ouner near         | sources, u |                           |        |
| Fractio             | n of hea                   | at from C           | Commun                | ity heat                | pump     |             |                |            |                 |            |                    |            | 1                         | (303a) |
| Fractio             | n of tota                  | al space            | heat fro              | m Comn                  | nunity h | eat pum     | р              |            |                 | (3         | 802) x (303        | 8a) =      | 1                         | (304a) |
| Factor              | for cont                   | rol and o           | charging              | method                  | (Table   | 4c(3)) fo   | or commu       | unity hea  | ating sys       | tem        |                    |            | 1                         | (305)  |
| Distrib             | ution los                  | s factor            | (Table 1              | 2c) for c               | commun   | ity heati   | ng syste       | m          |                 |            |                    |            | 1                         | (306)  |
| -                   | <b>heatin</b> g<br>I space | -                   | requiren              | nent                    |          |             |                |            |                 |            |                    |            | <b>kWh/yea</b><br>1133.31 | ır     |
| Spa <mark>ce</mark> | heat fro                   | m Com               | munity h              | eat pum                 | р        |             |                |            | (98) x (3       | 04a) x (30 | 5) x (306)         | =          | 1133.31                   | (307a) |
| Efficier            | ncy of se                  | econdary            | y/supple              | mentary                 | heating  | system      | in % (fro      | om Table   | e 4a or A       | ppendi     | E)                 |            | 0                         | (308   |
| Space               | heating                    | require             | ment fro              | m secon                 | dary/su  | pplemen     | ntary syst     | tem        | (98) x (3       | 01) x 100  | ÷ (308) =          |            | 0                         | (309)  |
| Water               | heating                    |                     |                       |                         |          |             |                |            |                 |            |                    |            |                           |        |
|                     |                            | -                   | equirem               | ent                     |          |             |                |            |                 |            |                    |            | 2062.88                   |        |
|                     |                            |                     | ty schen<br>nunity he | ne:<br>eat pump         | þ        |             |                |            | (64) x (3       | 03a) x (30 | 5) x (306)         | =          | 2062.88                   | (310a) |
| Electric            | city used                  | d for hea           | at distribu           | ution                   |          |             |                | 0.01       | × [(307a)       | (307e) -   | ⊦ (310a)…          | (310e)] =  | 31.96                     | (313)  |
| Cooling             | g Syster                   | m Energ             | y Efficie             | ncy Rati                | 0        |             |                |            |                 |            |                    |            | 0                         | (314)  |
| Space               | cooling                    | (if there           | is a fixe             | d coolin                | g syster | n, if not e | enter 0)       |            | = (107) ÷       | - (314) =  |                    |            | 0                         | (315)  |
|                     |                            |                     |                       | within dv<br>ced, extra |          |             | ):<br>put from | outside    |                 |            |                    |            | 173.81                    | (330a) |
| warm a              | air heati                  | ng syste            | m fans                |                         |          |             |                |            |                 |            |                    |            | 0                         | (330b) |
| pump f              | or solar                   | water h             | eating                |                         |          |             |                |            |                 |            |                    |            | 0                         | (330g) |
| Total e             | lectricity                 | / for the           | above, l              | kWh/yea                 | r        |             |                |            | =(330a)         | + (330b) + | - (330g) =         |            | 173.81                    | (331)  |
| Energy              | / for ligh                 | ting (cal           | culated i             | in Apper                | ndix L)  |             |                |            |                 |            |                    |            | 459.05                    | (332)  |
| Electric            | city gene                  | erated b            | y PVs (A              | Appendix                | : M) (ne | gative qu   | uantity)       |            |                 |            |                    |            | -664.99                   | (333)  |
| Electric            | city gene                  | erated b            | y wind tu             | urbine (A               | ppendi   | (ne         | gative qu      | antity)    |                 |            |                    |            | 0                         | (334)  |
| 12b. C              | O2 Emi                     | ssions –            | Commu                 | unity hea               | ting sch | ieme        |                |            |                 |            |                    |            |                           |        |
|                     |                            |                     |                       |                         |          |             |                |            | ergy<br>′h/year |            | missior<br>g CO2/k |            | Emissions<br>kg CO2/year  |        |
|                     |                            |                     | es of spa<br>ce 1 (%) | ace and v               | water he |             |                | g two fuel | s repeat (3     | 63) to (36 | 6) for the s       | second fue | 364                       | (367a) |

| CO2 associated with heat source 1         | [(307b                  | )+(310b)] x 100 ÷ (367b) x | 0.52      | ] =    | 455.72  | (367) |
|---|-------------------------|----------------------------|-----------|--------|---------|-------|
| Electrical energy for heat distribution   |                         | [(313) x                   | 0.52      | =      | 16.59   | (372) |
| Total CO2 associated with community       | systems                 | (363)(366) + (368)(3       | 372)      | =      | 472.31  | (373) |
| CO2 associated with space heating (se     | condary)                | (309) x                    | 0         | =      | 0       | (374) |
| CO2 associated with water from immer      | sion heater or instanta | neous heater (312) x       | 0.52      | =      | 0       | (375) |
| Total CO2 associated with space and w     | vater heating           | (373) + (374) + (375) =    |           |        | 472.31  | (376) |
| CO2 associated with electricity for pum   | ps and fans within dwe  | lling (331)) x             | 0.52      | =      | 90.21   | (378) |
| CO2 associated with electricity for light | ing                     | (332))) x                  | 0.52      | =      | 238.25  | (379) |
| Energy saving/generation technologies     | (333) to (334) as appli | cable                      | 0.52 X 0. | 01 – 🗖 |         |       |
| Item 1                                    |                         |                            | 0.52 X 0. |        | -345.13 | (380) |
| Total CO2, kg/year                        | sum of (376)(382) =     |                            |           |        | 455.63  | (383) |
| Dwelling CO2 Emission Rate                | (383) ÷ (4) =           |                            |           |        | 5.93    | (384) |
| El rating (section 14)                    |                         |                            |           |        | 94.99   | (385) |
|   |                         |                            |           |        |         |       |

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| Assessor Name:       Strom FSAP 2012       Strom Automation         Software Yasion:       Version:       Version:       1.04.23         Matter Strom       1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON       1.04.23         Coronal floor       1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON       1.02.25       (2)       1.02.25       (3)         Coronal floor       1.01       51.7       (4)       (3)  |                            |                                |              | User De            | etails:      |             |             |          |          |             |               |  |  |
|--|----------------------------|--------------------------------|--------------|--------------------|--------------|-------------|-------------|----------|----------|-------------|---------------|--|--|
| Address :       1 Bed Fait, 219-223 Coldharbour Lane, Loughborough Junction, LONDON         I. Vertial dwelling dimensions:       Area(m <sup>2</sup> )       Av. Height(m)       Volume(m <sup>2</sup> )         Ground floor       517       (1a) x       2.5       (2a) a       (2g) 25       (3a)         Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n)       517       (4)       (a)+(3c)+(3c)+(3c)+(3c)+(3c)+(3c)+(3c)+(3c  |                            | Stroma FSAP 201                |              | ;                  | Softwa       | re Ver      |             |          | Versio   | n: 1.0.4.23 |               |  |  |
| I. Overall dwelling dimensions:       Area(m?)       Av. Height(m)       Volume(m?)         Ground floor       51.7       (1a) x       Z.5       (2a) = $129.25$ (3a)         Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n)       51.7       (4)       129.25       (5)         Dwelling volume       (3a)+(3b)+(3c)+(3d)+(3e)+(3n) =       129.25       (5)         Iterating       secondary       other       total       m³ per hour         Number of chimneys       0       +       0       =       0       x40 =       0       (6a)         Number of pan flues       0       +       0       =       0       x40 =       0       (6a)         Number of pasive vents       0       +       0       =       0       x40 =       0       (7a)         Number of flueless gas fires       0       x40 =       0       (7a)       0       (7a)         Number of storeys in the dwelling (ns)       0       x40 =       0       (7a)         Additional infituation:       0.2 for steel or timber frame or 0.35 for masonry construction       (1b)       0       (10)         If a presentation set has been camed out or is instabled. proceed to (17) otherwase continuue from (3) is (16)       0  |                            | 4 Ded Elet 040 000             |              |                    |              |             | uh lunat    | ion ION  |          |             |               |  |  |
| Area(m <sup>2</sup> )Av. Height(m)Volume(m <sup>3</sup> )Ground floor51.7(a)2.5(ca)129.25(s)Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n)51.7(a)(a)+(a)+(a)+(a)+(a)+(a)+(a)+(a)+(a)+(a)+  |                            |                                | Coldnarb     | our Lar            | ne, Loug     | poroug      | gn Junct    | ion, LOP | IDON     |             |               |  |  |
| Dwelling volume $(3a)+(3b)+(3c)+(3c)+(3d)+(3d)+(3d)+(3d)+(3d)+(3d)+(3d)+(3d$   |                            |                                |              | -                  | · ,          | (1a) x      | <b></b>     |          | (2a) =   |             | -             |  |  |
| Number of chimneys       main heating       secondary       other       total       m³ per hour         Number of open flues $0$ <t< td=""><td>Total floor area TFA = (1</td><td>a)+(1b)+(1c)+(1d)+(1e</td><td>e)+(1n)</td><td>5</td><td>1.7</td><td>(4)</td><td></td><td></td><td></td><td></td><td></td></t<>  | Total floor area TFA = (1  | a)+(1b)+(1c)+(1d)+(1e          | e)+(1n)      | 5                  | 1.7          | (4)         |             |          |          |             |               |  |  |
| main<br>heating<br>heatingsecondary<br>heatingothertotalm² per hourNumber of chimneys0+0=0x40 =0(6a)Number of open flues0+0=0x20 =0(6b)Number of intermittent fans0x10 =077a)Number of passive vents0x10 =077b)Number of passive vents0x40 =077c)Number of titleless gas fires0x40 =077c)Infiltration due to chimneys, flues and fans =(66)+(6b)+(7a)+(7b)+(7b) =0+ (6) =0(6)If a pessurisation test has blen camed out or is intended, proceed to (77), otherwise continue from (9) to (76)0(9)(10)Structural infiltration(19)+1(b,1) =0(10)(10)(10)Structural infiltration0.25 for steel or timber frame or 0.35 for masonry construction0(12)If buspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 00(12)Percentage of windows and doors draught stripped0(14)Window infiltration rate(20) = 10.075 (19) =0Air permeability value, e\$0, expressed in cubic metres per hour per square metre of envelope area2(17)Air permeability value, e\$0, expressed in cubic metres per hour per square metre of envelope area2(17)Air permeability value, e\$0, expressed in cubic metres per hour per square metre of envelope area2(17)Air permeability value, a   |                            |                                |              |                    |              |             |             |          |          |             |               |  |  |
| Number of chimneys $0$ $1$ $0$ $0$ $1$ $0$ $0$ <t< td=""><td>2. Ventilation rate:</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>  | 2. Ventilation rate:       |                                |              |                    |              |             |             |          |          |             |               |  |  |
| Number of open flues $0$ + $0$ + $0$ = $0$ × $20$ = $0$ (6b)<br>Number of open flues $0$ + $0$ + $0$ = $0$ × $20$ = $0$ (6b)<br>Number of intermittent fans $0$ × $10$ = $0$ (7a)<br>Number of passive vents $0$ × $10$ = $0$ (7b)<br>Number of passive vents $0$ × $10$ = $0$ (7c)<br>Number of flueless gas fires $0$ × $40$ = $0$ (7c)<br>Number of flueless gas fires $0$ × $40$ = $0$ (7c)<br>Number of storeys in the dwelling (ns)<br>Additional infiltration $0$ (9)<br>Additional infiltration $0$ (9)<br>Structural infiltration $0$ (25 for steel or timber frame or $0.35$ for masonry construction<br>If supended wooden floor, enter $0.2$ (unsealed) or $0.1$ (sealed), else enter $0$<br>If supended wooden floor, enter $0.2$ (unsealed) or $0.1$ (sealed), else enter $0$<br>Percentage of windows and doors draught stripped<br>Window infiltration $0$ (25 - $[0.2 \times (14) + 100]$ = $0$ (15)<br>Infiltration rate $(6) + (10) + (11) + (12) + (13) + (15) =$ $0$ (16)<br>Air permeability value, ep0, expressed in cubic metres per hour per square metre of envelope area<br>2 (17)<br>Percentage of windows and bors draught stripped<br>Window infiltration $(20) = 1 + [0.075 \times (19)] =$ $(-16)$<br>Air permeability value, ep0, expressed in cubic metres per hour per square metre of envelope area<br>2 (17)<br>Air permeability value, ep0, expressed in cubic metres per hour per square metre of envelope area<br>2 (17)<br>Pienter factor $(20) = 1 + [0.075 \times (19)] =$ $0.08$ (21)<br>Infiltration rate incorporating shelter factor $(21) = (10.075 \times (19)] =$ $0.78$ (20)<br>Infiltration rate modified for monthly wind speed<br>Monthy average wind speed from Table 7<br>(22)m $5$ $1$ $5$ $4.9$ $4.4$ $4.3$ $3.8$ $3.8$ $3.7$ $4$ $4.3$ $4.5$ $4.7$<br>Wind Factor (22a)m $= (22)m \div 4$   | Number of chimpons         | heating h                      | neating      |                    |              | ı _ r       |             | ×/       | IO -     | -           | -             |  |  |
| Number of intermittent fans0 $x10 =$ 0(7a)Number of passive vents0 $x10 =$ 0(7c)Number of flueless gas fires0 $x40 =$ 0(7c)Air changes per hourInfiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7c)=$ 0 $+(5) =$ 0(8)If pressurisation test has been carred out or is intended, proceed to (17), otherwise continue from (9) to (16)Number of storeys in the dwelling (ns)Additional infiltration(19)-1):0.1 =0(10)Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry constructionif both ypes of will are present, use the value corresponding to the greater well area (after<br>deucting areas of openings); if equal user 0.35If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 00(12)If no draught lobby, enter 0.05, else enter 0O(14)Window infiltration0.25 - [0.2 x (14) + 100] =O(16)Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope areaO(17)Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope areaAir permeability value, applies if a pressurisation test has been done or a degree air permeability is being usedNumber of sides sheltered <t< td=""><td></td><td></td><td>-</td><td>¦</td><td></td><td>. L</td><td></td><td></td><td></td><td></td><td></td></t<>   |                            |                                | -            | ¦                  |              | . L         |             |          |          |             |               |  |  |
| Number of flueless gas fires<br>$ \begin{array}{c} 0 \\ \text{Number of flueless gas fires \end{array} $ $ \begin{array}{c} 0 \\ 0 \\ 0 \end{array} $ $ \begin{array}{c} 0 \\$ | ·                          |                                | 0            |                    | 0            | J L<br>T    | -           | x 1      | 0 =      |             |               |  |  |
| Number of flueless gas fires $0 \times 40 = 0$ (7c)<br>Air changes per hour<br>Infiltration due to chimneys, flues and fans = (\$e)+(6b)+(7a)+(7c) = 0 - (9) = 0 (8)<br>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (2) to (16)<br>Number of storeys in the dwelling (ns)<br>Additional infiltration (0.5) for steel or timber frame or 0.35 for masonry construction<br>if both types of wall are present, use the value corresponding to the greater wall area (after<br>deducting areas of openings); if equal user 0.35<br>If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)<br>If no draught lobby, enter 0.05, else enter 0 0 0 (13)<br>Percentage of windows and doors draught stripped<br>Window infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)<br>Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area<br>If based on air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16)<br>Air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16)<br>Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area<br>If based on air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16)<br>Air permeability value, q50, expressed in cubic metres per air permeability is being used<br>Number of sides sheltered<br>Shelter factor (20) = 1 - [0.075 x (19)] = 0.78 (20)<br>Infiltration rate modified for monthly wind speed<br>Lan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec<br>Monthly average wind speed from Table 7<br>(2)m 5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7<br>Wind Factor (22a)m = (22m ÷ 4)  | Number of passive vents    | 5                              |              |                    |              |             | 0           | x 1      | 0 =      | 0           | 」<br>┃(7b)    |  |  |
| Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 0 + (5) = 0$<br>It a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (76)<br>Number of storeys in the dwelling (ns)<br>Additional infiltration (9) to (76)<br>Additional infiltration (9) to (76)<br>Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction<br>if both types of wall are present, use the value corresponding to the greater wall area (after<br>deducting areas of openings); if equal user 0.35<br>If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0<br>If no draught lobby, enter 0.2, get enter 0<br>Percentage of windows and doors draught stripped<br>Window infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0<br>Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area<br>If based on air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16)<br>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used<br>Number of sides sheltered<br>Shelter factor (20) = 1 - [0.075 x (19)] = 0.78 (20)<br>Infiltration rate modified for monthly wind speed<br>Infiltration rate modified for monthly wind speed<br>Infiltration rate modified for monthly wind speed<br>Monthly average wind speed from Table 7<br>(22)me 5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7<br>Wind Factor (22a)m = (22)m ÷ 4   | ·                          |                                |              |                    |              |             | -           | x 4      | +0 =     | 0           |               |  |  |
| Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 0 + (5) = 0$<br>It a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (76)<br>Number of storeys in the dwelling (ns)<br>Additional infiltration (9)<br>Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction<br>if both types of wall are present, use the value corresponding to the greater wall area (after<br>deducting areas of openings); if equal user 0.35<br>If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0<br>If no draught lobby, enter 0.05, else enter 0<br>Percentage of windows and doors draught stripped<br>Window infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0<br>Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area<br>If based on air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16)<br>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used<br>Number of sides sheltered<br>Shelter factor (20) = 1 - [0.075 x (19)] = 0.78<br>Infiltration rate modified for monthly wind speed<br>Infiltration rate modified for monthly wind speed<br>Infiltration rate modified for monthly wind speed<br>Monthly average wind speed from Table 7<br>(22)me 5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7<br>Wind Factor (22a)m = (22)m ÷ 4   |                            |                                |              |                    |              |             |             |          |          |             |               |  |  |
| Number of storeys in the dwelling (ns)<br>Additional infiltration $0$ $0$ $0$ Additional infiltration0.25 for steel or timber frame or 0.35 for masonry construction<br>if both types of wall are present, use the value corresponding to the greater wall area (after<br>deducting areas of openings); if equal user 0.35 $0$ $0$ If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 $0$ $(12)$ If no draught lobby, enter 0.05, else enter 0 $0$ $(13)$ Percentage of windows and doors draught stripped $0$ $(14)$ Window infiltration $0.25 - [0.2 \times (14) + 100] =$ $0$ Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) =$ $0$ Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area $2$ If based on air permeability value, then $(18) = [(17) + 20] + (8)$ , otherwise $(18) = (16)$ $0.1$ Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used $3$ Number of sides sheltered $3$ $(19)$ Shelter factor $(20) = 1 - [0.075 \times (19)] =$ $0.08$ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ $0.08$ Infiltration rate modified for monthly wind speed $3$ $3.7$ $4$ Monthly average wind speed from Table 7 $(22) m = 5.1$ $5$ $4.9$ $(22) m = 5.1$ $5$ $4.9$ $4.4$ $3$ $3.8$ $3.7$ $4$ $4.3$ $4.5$ $4.7$  | Infiltration due to chimne | ys, flues and fans = (6        | a)+(6b)+(7a) | ) <b>+(7</b> b)+(7 | c) =         | Г           | 0           |          |          |             | -             |  |  |
| Additional infiltration((9)-1)x0.1 =0(10)Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry constructionif both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.350(11)If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 00(12)If no draught lobby, enter 0.05, else enter 00(13)Percentage of windows and doors draught stripped0(14)Window infiltration0.25 - [0.2 × (14) + 100] =0Infiltration rate(8) + (10) + (11) + (12) + (13) + (15) =0Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area2If based on air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16)0.1Air permeability value, applies if a pressurisation test has been done or a degree air permeability is being used1(9)Number of sides sheltered3(19)Shelter factor(20) = 1 - [0.075 × (19)] =0.08Infiltration rate incorporating shelter factor(21) = (18) × (20) =0.08JanFebMarAprMayJanFebMarAprMayMonthly average wind speed from Table 7(22)m =5.15(22)m =5.154.94.44.33.83.744.34.54.7   |                            |                                | ed, proceed  | to (17), o         | therwise c   | ontinue fro | om (9) to ( | (16)     |          |             | -             |  |  |
| if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35<br>If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0<br>If no draught lobby, enter 0.05, else enter 0<br>Percentage of windows and doors draught stripped<br>Window infiltration<br>0.25 · [0.2 x (14) + 100] =<br>0 (14)<br>Window infiltration<br>0.25 · [0.2 x (14) + 100] =<br>0 (15)<br>Infiltration rate<br>(8) + (10) + (11) + (12) + (13) + (15) =<br>0 (16)<br>Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area<br>2 (17)<br>If based on air permeability value, then (18) = [(17) + 20]+(8), otherwise (18) = (16)<br><i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i><br>Number of sides sheltered<br>Shelter factor<br>(20) = 1 - [0.075 x (19)] =<br>1nfiltration rate modified for monthly wind speed<br><u>Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec</u><br>Monthly average wind speed from Table 7<br>(22)me <u>5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7</u><br>Wind Factor (22a)m = (22)m ÷ 4  |                            | he dw <mark>elling</mark> (ns) |              |                    |              |             |             | [(9)-    | 1]x0.1 = |             | -             |  |  |
| deducting areas of openings); if equal user 0.35If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 00If no draught lobby, enter 0.05, else enter 00Percentage of windows and doors draught stripped0Window infiltration0.25 - [0.2 x (14) + 100] =Infiltration rate(8) + (10) + (11) + (12) + (13) + (15) =Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area2If based on air permeability value, then $(18) = [(17) + 20] + (8)$ , otherwise $(18) = (16)$ 0.1Air permeability value, applies if a pressurisation test has been done or a degree air permeability is being used3Number of sides sheltered3(19)Shelter factor(20) = 1 - [0.075 x (19)] =0.08Infiltration rate modified for monthly wind speed014JanFebMarAprMayJunJulAugSepOctNovDecMonthly average wind speed from Table 7220m =(22m =5.154.94.44.33.83.7Wind Factor (22a)m = (22)m ÷ 44.4  | Structural infiltration: 0 | .25 for steel or timber        | frame or 0   | ).35 for           | masonr       | y constr    | uction      |          |          | 0           | -<br>(11)     |  |  |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0If no draught lobby, enter 0.05, else enter 00Percentage of windows and doors draught stripped0Window infiltration $0.25 \cdot [0.2 \times (14) \div 100] =$ Infiltration rate(8) + (10) + (11) + (12) + (13) + (15) =Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area2If based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$ 0.1Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used3Number of sides sheltered3Shelter factor(20) = 1 - [0.075 \times (19)] =Infiltration rate modified for monthly wind speed0.08JanFebMarAprMayJunJulAugSepOctNovDecMonthly average wind speed from Table 7(22)m =5.154.94.44.33.83.744.34.34.54.7  |                            |                                | ponding to t | he greate          | er wall area | a (after    |             |          |          |             | -             |  |  |
| If no draught lobby, enter 0.05, else enter 00Percentage of windows and doors draught stripped0Window infiltration $0.25 - [0.2 \times (14) \div 100] =$ Infiltration rate(8) + (10) + (11) + (12) + (13) + (15) =Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area2If based on air permeability value, then (18) = [(17) $\div 20]$ +(8), otherwise (18) = (16)0.1Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used3Number of sides sheltered3Shelter factor(20) = 1 - [0.075 x (19)] =Infiltration rate modified for monthly wind speed0.08JanFebMarAprMayJunJunAugSepOctNovDecMonthly average wind speed from Table 7(22)m =5.154.94.44.33.83.744.34.34.54.7   |                            |                                | led) or 0.1  | (sealed            | d), else     | enter 0     |             |          |          | 0           | <b>]</b> (12) |  |  |
| Window infiltration $0.25 - [0.2 \times (14) + 100] =$ $0$ (15)Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) =$ $0$ (16)Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area $2$ (17)If based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$ $0.1$ (18)Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used $0.1$ (18)Number of sides sheltered $3$ (19)Shelter factor $(20) = 1 - [0.075 \times (19)] =$ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ $0.08$ (21)Infiltration rate modified for monthly wind speed $\boxed{20}$ Infiltration rate modified for Table 7 $(22)$ m = $5.1$ $5$ $4.9$ $4.4$ $4.3$ $3.8$ $3.8$ $3.7$ $4$ $4.3$ $4.5$ $4.7$ Wind Factor (22a)m = (22)m ÷ 4  | If no draught lobby, en    | ter 0.05, else enter 0         | ,            | ,                  | ,,           |             |             |          |          |             | 4             |  |  |
| Infiltration rate(10)Infiltration rate(8) + (10) + (11) + (12) + (13) + (15) =0(16)Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area2(17)If based on air permeability value, then $(18) = [(17) \div 20]+(8)$ , otherwise $(18) = (16)$ 0.1(18)Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used0.1(18)Number of sides sheltered3(19)Shelter factor(20) = 1 - [0.075 x (19)] =0.78(20)Infiltration rate incorporating shelter factor(21) = (18) x (20) =0.08(21)Infiltration rate modified for monthly wind speed $3.8$ $3.7$ $4$ $4.3$ $4.5$ $4.7$ Wind Factor (22a)m = (22)m $\div 4$ $4.4$ $4.3$ $3.8$ $3.7$ $4$ $4.3$ $4.5$ $4.7$   | Percentage of window       | s and doors draught st         | tripped      |                    |              |             |             |          |          | 0           | (14)          |  |  |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope areaIf based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$ 0.1(18)Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used0.1(18)Number of sides sheltered3(19)Shelter factor(20) = 1 - [0.075 x (19)] =0.78Infiltration rate incorporating shelter factor(21) = (18) x (20) =0.08Infiltration rate modified for monthly wind speed0.10.08Monthly average wind speed from Table 754.94.4Wind Factor (22a)m = (22)m ÷ 44.33.83.83.744.34.54.7  | Window infiltration        |                                |              | (                  | 0.25 - [0.2  | x (14) ÷ 1  | = [00       |          |          | 0           | (15)          |  |  |
| If based on air permeability value, then $(18) = [(17) \div 20]+(8)$ , otherwise $(18) = (16)$<br>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used<br>Number of sides sheltered<br>Shelter factor (20) = 1 - [0.075 x (19)] =<br>Infiltration rate incorporating shelter factor (21) = (18) x (20) =<br>Infiltration rate modified for monthly wind speed<br>Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec<br>Monthly average wind speed from Table 7<br>(22)m= 5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7<br>Wind Factor (22a)m = (22)m ÷ 4  | Infiltration rate          |                                |              | (                  | (8) + (10) - | + (11) + (1 | 2) + (13) - | + (15) = |          | 0           | (16)          |  |  |
| Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used<br>Number of sides sheltered<br>Shelter factor $(20) = 1 - [0.075 \times (19)] =$<br>Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$<br>Infiltration rate modified for monthly wind speed<br>Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec<br>Monthly average wind speed from Table 7<br>(22)m = 5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7<br>Wind Factor $(22a)m = (22)m \div 4$  |                            | • • •                          |              | •                  | •            | •           | etre of e   | nvelope  | area     | 2           | (17)          |  |  |
| Number of sides sheltered3Shelter factor $(20) = 1 - [0.075 \times (19)] =$ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ Infiltration rate modified for monthly wind speed $0.08$ JanFebMarAprMayJunJulAugSepOctNovDecMonthly average wind speed from Table 7(22)m= $5.1$ $5$ $4.9$ $4.4$ $4.3$ $3.8$ $3.7$ $4$ $4.3$ $4.3$ $4.5$ $4.7$  | •                          | •                              |              |                    |              |             |             |          |          | 0.1         | (18)          |  |  |
| Shelter factor $(20) = 1 - [0.075 \times (19)] =$ $0.78$ $(20)$ Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ $0.08$ $(21)$ Infiltration rate modified for monthly wind speed $0.08$ $(21)$ Infiltration rate modified for monthly wind speedMarAprMayJunJulAugSepOctNovDecMonthly average wind speed from Table 7 $(22)m=$ $5.1$ $5$ $4.9$ $4.4$ $4.3$ $3.8$ $3.7$ $4$ $4.3$ $4.5$ $4.7$ \div 4\div 4\div 4\div 4  |                            |                                | s been done  | or a degi          | ree air per  | meability i | is being us | sed      |          |             |               |  |  |
| Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ $0.08$ $(21)$ Infiltration rate modified for monthly wind speed $\overline{0.08}$ $(21)$ $\overline{0.08}$ $(21)$ Infiltration rate modified for monthly wind speed $\overline{140}$ $\overline{140}$ $\overline{140}$ $\overline{120}$ $\overline{0.08}$ $(21)$ Infiltration rate modified for monthly wind speed $\overline{140}$ $\overline{140}$ $\overline{140}$ $\overline{140}$ $\overline{120}$ $\overline{100}$  |                            | eu                             |              | (                  | (20) = 1 - [ | 0.075 x (1  | 9)] =       |          |          |             | -             |  |  |
| Infiltration rate modified for monthly wind speed         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec         Monthly average wind speed from Table 7  |                            | ting shelter factor            |              |                    |              |             |             |          |          |             | 4             |  |  |
| JanFebMarAprMayJunJulAugSepOctNovDecMonthly average wind speed from Table 7 $(22)m=$ $5.1$ $5$ $4.9$ $4.4$ $4.3$ $3.8$ $3.7$ $4$ $4.3$ $4.5$ $4.7$ Wind Factor (22a)m = (22)m ÷ 4  |                            | -                              | d            |                    |              |             |             |          |          | 0.00        | J(=.)         |  |  |
| $(22)m = \begin{bmatrix} 5.1 & 5 & 4.9 & 4.4 & 4.3 & 3.8 & 3.8 & 3.7 & 4 & 4.3 & 4.5 & 4.7 \end{bmatrix}$ Wind Factor (22a)m = (22)m ÷ 4   |                            |                                | <u> </u>     | Jul                | Aug          | Sep         | Oct         | Nov      | Dec      |             |               |  |  |
| Wind Factor (22a)m = (22)m $\div$ 4  | Monthly average wind sp    | beed from Table 7              |              |                    |              |             |             |          |          |             |               |  |  |
|  | <u> </u>                   | <u> </u>                       | 3.8          | 3.8                | 3.7          | 4           | 4.3         | 4.5      | 4.7      |             |               |  |  |
|  | Wind Factor $(22a)m = (2)$ | 2)m ÷ 4                        |              |                    |              |             |             |          |          |             |               |  |  |
|  |                            | ·                              | 0.95         | 0.95               | 0.92         | 1           | 1.08        | 1.12     | 1.18     |             |               |  |  |

| Adjust   | ed infiltr               | ation rat    | e (allowi      | ng for sl   | nelter an                 | d wind s       | peed) =        | (21a) x         | (22a)m       | -              | -           |           |           |               |
|----------|--------------------------|--------------|----------------|-------------|---------------------------|----------------|----------------|-----------------|--------------|----------------|-------------|-----------|-----------|---------------|
| <b>.</b> | 0.1                      | 0.1          | 0.09           | 0.09        | 0.08                      | 0.07           | 0.07           | 0.07            | 0.08         | 0.08           | 0.09        | 0.09      |           |               |
|          | ate effec<br>echanica    |              | -              | rate for t  | he appli                  | cable ca       | se             |                 |              |                |             |           | 0.5       | (23a)         |
|          |                          |              |                | endix N. (2 | 23b) = (23a               | ) × Fmv (e     | equation (N    | N5)) . othei    | rwise (23b   | ) = (23a)      |             |           | 0.5       | (23a)         |
|          |                          |              |                |             | allowing for              |                |                |                 |              | , (,           |             |           | 73.1      | (23c)         |
|          |                          |              | -              | -           | with hea                  |                |                |                 |              | 2h)m + (       | 23h) x [′   | 1 – (23c) |           | (200)         |
| (24a)m=  |                          | 0.23         | 0.23           | 0.22        | 0.22                      | 0.21           | 0.21           | 0.21            | 0.21         | 0.22           | 0.22        | 0.23      |           | (24a)         |
|          |                          | d mech       | I<br>anical ve | Intilation  | without                   | heat rec       | L<br>coverv (N | I<br>/\\/) (24b | l = (22)     | l<br>2b)m + (; | 1<br>23h)   |           |           |               |
| (24b)m=  |                          | 0            |                | 0           | 0                         | 0              | 0              | 0               | 0            | 0              | 0           | 0         |           | (24b)         |
|          |                          | ouse ex      | ract ver       | tilation o  | or positiv                | re input v     | ventilatio     | n from c        | utside       |                |             |           |           |               |
| ,        |                          |              |                |             | c) = (23b                 | •              |                |                 |              | 5 × (23b       | )           |           |           |               |
| (24c)m=  | 0                        | 0            | 0              | 0           | 0                         | 0              | 0              | 0               | 0            | 0              | 0           | 0         |           | (24c)         |
| d) If    | natural                  | ventilatio   | on or wh       | ole hous    | se positiv                | e input        | ventilatio     | on from I       | oft          |                |             |           |           |               |
|          | <u> </u>                 | n = 1, th    | en (24d)       | m = (22     | b)m othe                  | rwise (2       | ,<br>          | 0.5 + [(2       | 2b)m² x      | 0.5]           |             |           | 1         |               |
| (24d)m=  |                          | 0            | 0              | 0           | 0                         | 0              | 0              | 0               | 0            | 0              | 0           | 0         |           | (24d)         |
|          |                          |              |                | <u>``</u>   | i) or (24b                | , ,            | , <u>,</u>     | <i>,</i>        | · ,          | r              | 1           | 1         | I         | ()            |
| (25)m=   | 0.23                     | 0.23         | 0.23           | 0.22        | 0.22                      | 0.21           | 0.21           | 0.21            | 0.21         | 0.22           | 0.22        | 0.23      |           | (25)          |
| 3. He    | at l <mark>osse</mark>   | s and he     | eat loss       | oaramet     | er:                       |                |                |                 |              |                |             |           |           |               |
|          |                          | Gros<br>area |                | Openin      | lgs                       | Net Ar<br>A ,r |                | U-valı<br>W/m2  |              | A X U<br>(W/I  |             | k-value   |           | A X k<br>kJ/K |
| Windo    | ws Type                  |              | (111-)         |             |                           | 13.5           |                | [1/( 0.73 )+    |              | 9.58           |             | NJ/111-1  | `         | (27)          |
|          | ws Type                  |              |                |             |                           |                |                | [1/( 0.73 )+    | Ļ            | 2.07           | H           |           |           | (27)          |
| Walls    |                          |              |                | 40.5        |                           | 2.925          |                |                 |              | _              | H r         |           |           |               |
|          |                          | 29           | ,              | 13.5        | =                         | 15.5           |                | 0.15            |              | 2.33           | 닉 ¦         |           |           | (29)          |
| Walls    |                          | 5            |                | 2.92        | <u></u>                   | 2.08           | ×              | 0.15            |              | 0.31           | ╡┟          |           | $\dashv$  | (29)          |
| Walls    |                          | 18           |                | 0           |                           | 18             | ×              | 0.15            | =            | 2.7            |             |           |           | (29)          |
|          | area of e                | iements      | , m²           |             |                           | 52             |                |                 |              |                |             |           |           | (31)          |
| Party    |                          |              |                |             |                           | 44.25          | 5 X            | 0               | =            | 0              | L           |           | $\exists$ | (32)          |
| Party f  |                          |              |                |             |                           | 51.7           |                |                 |              |                | Ĺ           |           | $\_$ $\_$ | (32a)         |
| Party    | Ũ                        |              |                |             |                           | 51.7           |                |                 |              |                | Ĺ           |           |           | (32b)         |
| Interna  | al wall **               |              |                |             |                           | 77             |                |                 |              |                |             |           |           | (32c)         |
|          |                          |              |                |             | indow U-va<br>Is and part |                | ated using     | formula 1.      | /[(1/U-valu  | ie)+0.04] a    | as given in | paragraph | 1 3.2     |               |
| Fabric   | heat los                 | s, W/K       | = S (A x       | U)          |                           |                |                | (26)(30)        | + (32) =     |                |             |           | 16.99     | (33)          |
| Heat c   | apacity                  | Cm = S(      | (Axk)          |             |                           |                |                |                 | ((28)        | .(30) + (32    | 2) + (32a). | (32e) =   | 13882.3   | (34)          |
| Therm    | al mass                  | parame       | ter (TM        | - Cm -      | + TFA) in                 | ı kJ/m²K       |                |                 | Indica       | tive Value     | : Medium    |           | 250       | (35)          |
|          | ign assess<br>used inste |              |                |             | constructi                | ion are not    | t known pr     | ecisely the     | e indicative | values of      | TMP in Ta   | able 1f   |           |               |
|          |                          |              |                |             | using Ap                  | pendix ł       | <              |                 |              |                |             |           | 7.96      | (36)          |
|          | -                        |              | ,              |             | = 0.05 x (3               | -              | -              |                 |              |                |             |           | 1.30      |               |
|          | abric he                 |              |                | . ,         |                           |                |                |                 | (33) +       | (36) =         |             |           | 24.95     | (37)          |
| Ventila  | ation hea                | at loss ca   | alculated      | monthl      | у                         |                |                |                 | (38)m        | = 0.33 × (     | 25)m x (5)  |           |           |               |
|          | Jan                      | Feb          | Mar            | Apr         | May                       | Jun            | Jul            | Aug             | Sep          | Oct            | Nov         | Dec       |           |               |

| (38)m=     | 9.95                 | 9.87                 | 9.79                    | 9.37        | 9.29           | 8.88        | 8.88        | 8.79        | 9.04       | 9.29                     | 9.46                    | 9.62          |         | (38) |
|------------|----------------------|----------------------|-------------------------|-------------|----------------|-------------|-------------|-------------|------------|--------------------------|-------------------------|---------------|---------|------|
| Heat tra   | ansfer o             | coefficie            | nt, W/K                 |             |                |             |             |             | (39)m      | = (37) + (3              | 38)m                    |               |         |      |
| (39)m=     | 34.9                 | 34.82                | 34.73                   | 34.32       | 34.24          | 33.82       | 33.82       | 33.74       | 33.99      | 34.24                    | 34.4                    | 34.57         |         |      |
| Heat la    |                      | motor (l             | יאי (סור                | /m2k        |                |             |             |             |            | Average =                |                         | 12 /12=       | 34.3    | (39) |
| (40)m=     | 0.68                 | 0.67                 | HLP), W/                | 0.66        | 0.66           | 0.65        | 0.65        | 0.65        | 0.66       | = (39)m ÷<br>0.66        | ( <del>4)</del><br>0.67 | 0.67          | l       |      |
| (40)11-    | 0.00                 | 0.07                 | 0.07                    | 0.00        | 0.00           | 0.00        | 0.00        | 0.00        |            | Average =                |                         |               | 0.66    | (40) |
| Numbe      | er of day            | vs in mo             | nth (Tab                | le 1a)      |                |             | -           |             |            |                          |                         |               |         |      |
|            | Jan                  | Feb                  | Mar                     | Apr         | May            | Jun         | Jul         | Aug         | Sep        | Oct                      | Nov                     | Dec           |         |      |
| (41)m=     | 31                   | 28                   | 31                      | 30          | 31             | 30          | 31          | 31          | 30         | 31                       | 30                      | 31            |         | (41) |
|            |                      |                      |                         |             |                |             |             |             |            |                          |                         |               |         |      |
| 4. Wa      | ter heat             | ting ene             | rgy requi               | irement:    |                |             |             |             |            |                          |                         | kWh/ye        | ear:    |      |
|            |                      | ipancy,              |                         | [4 over     | ( 0 0000       | 40 v /T     | - 42.0      |             | 040 x (    |                          |                         | 74            | I       | (42) |
|            | A > 13.9<br>A £ 13.9 |                      | + 1.76 x                | i [1 - exp  | (-0.0003       | 49 X (11    | -A -13.9    | )2)] + 0.0  | JU13 X (   | IFA -13.                 | 9)                      |               |         |      |
|            |                      |                      | ater usag               |             |                |             |             |             |            |                          |                         | .53           |         | (43) |
|            |                      | -                    | hot water<br>person per |             |                | -           | -           | to achieve  | a water us | se target o              | f                       |               |         |      |
|            | Jan                  | Feb                  | ,<br>Mar                | Apr         | May            | Jun         | Jul         | Aug         | Sep        | Oct                      | Nov                     | Dec           |         |      |
| Hot wate   |                      |                      | r day for ea            |             |                |             |             | U U         | Oep        | 001                      | 1100                    |               |         |      |
| (44)m=     | <mark>8</mark> 3.08  | 80.06                | 77.04                   | 74.02       | 71             | 67.98       | 67.98       | 71          | 74.02      | 77.04                    | 80.06                   | <b>8</b> 3.08 |         |      |
|            |                      |                      |                         |             |                |             |             |             |            | Total = Su               | m(44) <sub>112</sub> =  | _             | 906.36  | (44) |
| Energy o   | content of           | hot water            | used - cal              | culated mo  | onthly $= 4$ . | 190 x Vd,r  | m x nm x E  | )Tm / 3600  | ) kWh/mor  | oth (see Ta              | bles 1b, 1              | c, 1d)        |         |      |
| (45)m=     | 123.21               | 107.76               | 111.2                   | 96.95       | 93.02          | 80.27       | 74.38       | 85.36       | 86.37      | 100.66                   | 109.88                  | 119.32        |         |      |
| lf instant | aneous w             | ater heati           | ng at point             | of use (no  | hot water      | storage)    | enter () in | hoxes (46   |            | Tota <mark>l = Su</mark> | m(45) <sub>112</sub> =  | -             | 1188.38 | (45) |
| (46)m=     | 18.48                | 16.16                | 16.68                   | 14.54       | 13.95          | 12.04       | 11.16       | 12.8        | 12.96      | 15.1                     | 16.48                   | 17.9          |         | (46) |
| · · ·      | storage              |                      | 10.00                   | 14.04       | 13.95          | 12.04       | 11.10       | 12.0        | 12.90      | 15.1                     | 10.40                   | 17.9          |         | (40) |
| Storage    | e volum              | e (litres)           | ) includir              | ng any so   | olar or W      | /WHRS       | storage     | within sa   | ame ves    | sel                      |                         | 180           |         | (47) |
| If comr    | nunity h             | eating a             | and no ta               | nk in dw    | velling, e     | nter 110    | litres in   | (47)        |            |                          |                         |               |         |      |
|            |                      |                      | hot wate                | er (this ir | icludes i      | nstantar    | neous co    | mbi boil    | ers) ente  | er '0' in (              | 47)                     |               |         |      |
|            | storage              |                      | eclared I               | oss facto   | or is kno      | wn (kWł     | n/dav).     |             |            |                          |                         | 0             |         | (48) |
| ,          |                      |                      | m Table                 |             |                | (           | " ddy / .   |             |            |                          |                         | 0             |         | (49) |
|            |                      |                      | storage                 |             | ear            |             |             | (48) x (49) | ) =        |                          |                         | 80            |         | (10) |
|            |                      |                      | eclared of              | -           |                | or is not   |             |             |            |                          |                         |               |         | ()   |
|            |                      | -                    | factor fr               |             | e 2 (kW        | h/litre/da  | ıy)         |             |            |                          | 0.                      | 01            |         | (51) |
|            | •                    | leating s<br>from Ta | ee secti<br>ble 2a      | on 4.3      |                |             |             |             |            |                          |                         | 07            |         | (52) |
|            |                      |                      | m Table                 | 2b          |                |             |             |             |            |                          |                         | 87<br>.6      |         | (52) |
|            |                      |                      | <sup>.</sup> storage    |             | ear            |             |             | (47) x (51) | x (52) x ( | 53) =                    |                         | 97            |         | (54) |
|            |                      | (54) in (5           | -                       | , ,         |                |             |             |             |            |                          |                         | 97            |         | (55) |
| Water      | storage              | loss cal             | culated f               | for each    | month          |             |             | ((56)m = (  | 55) × (41) | m                        |                         |               |         |      |
| (56)m=     | 30.09                | 27.18                | 30.09                   | 29.12       | 30.09          | 29.12       | 30.09       | 30.09       | 29.12      | 30.09                    | 29.12                   | 30.09         |         | (56) |
| If cylinde | er contains          | s dedicate           | d solar sto             | rage, (57)  | m = (56)m      | x [(50) – ( | H11)] ÷ (5  | 0), else (5 | 7)m = (56) | m where (                | H11) is fro             | m Append      | ix H    |      |
| (57)m=     | 30.09                | 27.18                | 30.09                   | 29.12       | 30.09          | 29.12       | 30.09       | 30.09       | 29.12      | 30.09                    | 29.12                   | 30.09         |         | (57) |

| •                             | Primary circuit loss (annual) from Table 3 O Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m |            |             |            |           |             |                  |              |                           |              |             |                         |      |
|-------------------------------|--|------------|-------------|------------|-----------|-------------|------------------|--------------|---------------------------|--------------|-------------|-------------------------|------|
| (modified b                   |  |            |             |            | · ·       | . ,         | • • •            |              | r thermo                  | stat)        |             |                         |      |
| (59)m= 23.26                  | 21.01  | 23.26      | 22.51       | 23.26      | 22.51     | 23.26       | 23.26            | 22.51        | 23.26                     | 22.51        | 23.26       |                         | (59) |
| Combi loss ca                 | alculated  | for each   | month       | (61)m =    | (60) ÷ 3  | 65 x (41    | )m               |              |                           |              |             |                         |      |
| (61)m= 0                      | 0  | 0          | 0           | 0          | 0         | 0           | 0                | 0            | 0                         | 0            | 0           |                         | (61) |
| Total heat req                | uired for  | water h    | eating ca   | alculated  | l for eac | h month     | (62)m =          | • 0.85 × (   | (45)m +                   | (46)m +      | (57)m +     | (59)m + (6 <sup>-</sup> | 1)m  |
| (62)m= 176.56                 | 155.95   | 164.55     | 148.58      | 146.38     | 131.9     | 127.74      | 138.71           | 138.01       | 154.01                    | 161.51       | 172.68      |                         | (62) |
| Solar DHW input               | calculated   | using App  | endix G o   | r Appendix | H (negati | ve quantity | y) (enter '0     | ' if no sola | r contribut               | ion to wate  | er heating) |                         |      |
| (add additiona                | al lines if  | FGHRS      | and/or \    | WWHRS      | applies   | , see Ap    | pendix (         | G)           |                           | -            | -           |                         |      |
| (63)m= 0                      | 0  | 0          | 0           | 0          | 0         | 0           | 0                | 0            | 0                         | 0            | 0           |                         | (63) |
| Output from w                 | vater hea  | ater       |             |            |           |             |                  |              |                           |              |             |                         |      |
| (64)m= 176.56                 | 155.95   | 164.55     | 148.58      | 146.38     | 131.9     | 127.74      | 138.71           | 138.01       | 154.01                    | 161.51       | 172.68      |                         |      |
|                               |  |            |             |            |           |             | Out              | out from wa  | ater heate                | r (annual)₁  | 12          | 1816.58                 | (64) |
| Heat gains fro                | m water  | heating    | , kWh/m     | onth 0.2   | 5 ´ [0.85 | × (45)m     | ı + (61)n        | n] + 0.8 >   | k [(46)m                  | + (57)m      | + (59)m     | ]                       |      |
| (65)m= 83.65                  | 74.38  | 79.66      | 73.54       | 73.61      | 68        | 67.42       | 71.06            | 70.03        | 76.15                     | 77.84        | 82.36       |                         | (65) |
| include (57)                  | m in cal   | culation   | of (65)m    | only if c  | ylinder i | s in the o  | dwelling         | or hot w     | ate <mark>r is f</mark> r | om com       | munity h    | eating                  |      |
| 5. Internal g                 | ains (see  | e Table {  | 5 and 5a    | ):         |           |             |                  |              |                           |              |             |                         |      |
| Met <mark>abolic</mark> gai   | ns (Table  | e 5), Wat  | ts          |            |           |             |                  |              |                           |              |             |                         |      |
| Jan                           | Feb  | Mar        | Apr         | May        | Jun       | Jul         | Aug              | Sep          | Oct                       | Nov          | Dec         |                         |      |
| (66)m= 87.01                  | 87.01  | 87.01      | 87.01       | 87.01      | 87.01     | 87.01       | 87.01            | 87.01        | 8 <mark>7.01</mark>       | 87.01        | 87.01       |                         | (66) |
| Ligh <mark>ting g</mark> ains | (calcula   | ited in Ap | opendix     | L, equat   | ion L9 o  | r L9a), a   | lso see          | Table 5      |                           |              |             |                         |      |
| (67)m= 18.06                  | 16.04  | 13.04      | 9.88        | 7.38       | 6.23      | 6.73        | 8.75             | 11.75        | 14.92                     | 17.41        | 18.56       |                         | (67) |
| Appliances ga                 | ains (calc   | culated in | n Appeno    | dix L, eq  | uation L  | 13 or L1    | 3a), also        | o see Ta     | ble 5                     |              |             |                         |      |
| (68)m= 151.65                 | 153.22   | 149.26     | 140.81      | 130.16     | 120.14    | 113.45      | 111.88           | 115.84       | 124.28                    | 134.94       | 144.96      |                         | (68) |
| Cooking gains                 | s (calcula   | ated in A  | ppendix     | L, equa    | tion L15  | or L15a     | ), also se       | ee Table     | 5                         |              |             |                         |      |
| (69)m= 31.7                   | 31.7   | 31.7       | 31.7        | 31.7       | 31.7      | 31.7        | 31.7             | 31.7         | 31.7                      | 31.7         | 31.7        |                         | (69) |
| Pumps and fa                  | ins gains  | (Table     | 5a)         |            | -         | -           | -                | -            | -                         |              |             |                         |      |
| (70)m= 0                      | 0  | 0          | 0           | 0          | 0         | 0           | 0                | 0            | 0                         | 0            | 0           |                         | (70) |
| Losses e.g. e                 | vaporatio  | on (nega   | tive valu   | es) (Tab   | ole 5)    | -           |                  |              |                           |              |             |                         |      |
| (71)m= -69.61                 | -69.61   | -69.61     | -69.61      | -69.61     | -69.61    | -69.61      | -69.61           | -69.61       | -69.61                    | -69.61       | -69.61      |                         | (71) |
| Water heating                 | ,<br>gains (1  | Fable 5)   | •           |            | •         |             | •                | •            | •                         |              |             |                         |      |
| (72)m= 112.43                 | 110.69   | 107.07     | 102.14      | 98.94      | 94.44     | 90.61       | 95.52            | 97.26        | 102.36                    | 108.11       | 110.7       |                         | (72) |
| Total interna                 | I gains =  | -          |             |            | (66)      | )m + (67)n  | •<br>n + (68)m · | + (69)m + (  | (70)m + (7                | 1)m + (72)   | m           |                         |      |
| (73)m= 331.24                 | 329.05   | 318.47     | 301.93      | 285.58     | 269.92    | 259.9       | 265.25           | 273.95       | 290.66                    | 309.57       | 323.32      |                         | (73) |
| 6. Solar gain                 | s:   |            |             | •          |           |             |                  |              |                           | •            |             |                         |      |
| Solar gains are               | calculated   | using sola | r flux from | Table 6a   | and assoc | iated equa  | ations to co     | onvert to th | ne applicat               | ole orientat | ion.        |                         |      |
| Orientation <sup>.</sup>      | Arress F   | Factor     | Area        |            | Fli       | IY          |                  | a            |                           | FF           |             | Gains                   |      |

| Orientation:   | Access Facto<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|----------------|--------------------------|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Northeast 0.9x | 0.77                     | x | 2.92       | x | 11.28            | × | 0.63           | x | 0.1            | = | 1.44         | (75) |
| Northeast 0.9x | 0.77                     | x | 2.92       | × | 22.97            | × | 0.63           | × | 0.1            | = | 2.93         | (75) |

|                          |                            |            |   |            |          |         |           |        |            |          | -    |               |          | _   |       | _    |
|--------------------------|----------------------------|------------|---|------------|----------|---------|-----------|--------|------------|----------|------|---------------|----------|-----|-------|------|
| Northeast                | 0.9x 0.77                  | 7          | ( 2   | .92        | x        | 41      | 1.38      | x      | 0.63       |          | ×    | 0.1           | =        |     | 5.28  | (75) |
| Northeast                | 0.9x 0.77                  | 7 )        | 2   | .92        | x        | 67      | 7.96      | x      | 0.63       |          | ×    | 0.1           | =        | -   | 8.68  | (75) |
| Northeast                | 0.9x 0.77                  | 7 )        | ( 2   | .92        | x        | 91      | 1.35      | x      | 0.63       |          | × [  | 0.1           | =        | -   | 11.67 | (75) |
| Northeast                | 0.9x 0.77                  | 7 )        | ( 2   | .92        | x        | 97      | 7.38      | x      | 0.63       |          | × [  | 0.1           | =        | -   | 12.44 | (75) |
| Northeast                | 0.9x 0.77                  | 7          | ( 2   | .92        | x        | 9       | 1.1       | x      | 0.63       |          | × [  | 0.1           | =        | - [ | 11.63 | (75) |
| Northeast                | 0.9x 0.77                  | 7 )        | 2   | .92        | x        | 72      | 2.63      | x      | 0.63       |          | × [  | 0.1           | =        | -   | 9.27  | (75) |
| Northeast                | 0.9x 0.77                  | 7 )        | 2   | .92        | x        | 50      | ).42      | x      | 0.63       |          | × [  | 0.1           | =        | - [ | 6.44  | (75) |
| Northeast                | 0.9x 0.77                  | 7 )        | 2   | .92        | x        | 28      | 3.07      | x      | 0.63       |          | × [  | 0.1           | =        | - [ | 3.58  | (75) |
| Northeast                | 0.9x 0.77                  | 7 )        | 2   | .92        | x        | 1.      | 4.2       | x      | 0.63       |          | × [  | 0.1           | =        | -   | 1.81  | (75) |
| Northeast                | 0.9x 0.77                  | 7          | 2   | .92        | x        | 9       | .21       | ×      | 0.63       |          | × [  | 0.1           | =        |     | 1.18  | (75) |
| Southwest                | 0.9x 0.77                  | 7 )        | ۲ ا   | 3.5        | x        | 36      | 6.79      | ]      | 0.63       |          | × [  | 0.1           | =        | -   | 21.69 | (79) |
| Southwest                | 0.9x 0.77                  | 7 >        | ۲ (   | 3.5        | x        | 62      | 2.67      | ]      | 0.63       |          | × [  | 0.1           | =        |     | 36.94 | (79) |
| Southwest                | 0.9x 0.77                  | 7 >        | ۲ (   | 3.5        | x        | 85      | 5.75      | ]      | 0.63       |          | × [  | 0.1           | =        | -   | 50.54 | (79) |
| Southwest                | 0.9x 0.77                  | 7 >        | ۲ (   | 3.5        | x        | 10      | 6.25      | ]      | 0.63       |          | × [  | 0.1           | =        | -   | 62.62 | (79) |
| Southwest                | 0.9x 0.77                  | 7 )        | ۲ (   | 3.5        | x        | 11      | 9.01      | ]      | 0.63       |          | × [  | 0.1           | =        | -   | 70.14 | (79) |
| Southwest                | 0.9x 0.77                  | 7 )        | ۲ (   | 3.5        | x        | 11      | 8.15      | ]      | 0.63       |          | × [  | 0.1           | =        | - [ | 69.64 | (79) |
| Southwest                | 0.9x 0.77                  | 7 )        | ۲ ا   | 3.5        | x        | 11      | 3.91      | ]      | 0.63       |          | × [  | 0.1           | =        | -   | 67.14 | (79) |
| Southwest                | 0.9x 0.77                  | 7 <b>)</b> | ( 1   | 3.5        | x        | 10      | 4.39      |        | 0.63       |          | x    | 0.1           | =        |     | 61.53 | (79) |
| Southwest                | 0.9x 0.77                  | 7 <b>)</b> | ( 1   | 3.5        | х        | 92      | 2.85      |        | 0.63       |          | x [  | 0.1           |          |     | 54.73 | (79) |
| Southwest                | 0.9x 0.77                  | 7          | ( 1   | 3.5        | x        | 69      | 9.27      |        | 0.63       |          | x [  | 0.1           | =        | -   | 40.83 | (79) |
| Southwest                | 0.9x 0.77                  | 7          | ( 1   | 3.5        | x        | 44      | 4.07      |        | 0.63       |          | x [  | 0.1           | =        | - [ | 25.98 | (79) |
| Sout <mark>hwes</mark> t | 0.9x 0.77                  | 7          | ( 1   | 3.5        | x        | 31      | 1.49      |        | 0.63       |          | ×    | 0.1           | _ =      | • [ | 18.56 | (79) |
|                          |                            |            |   |            |          |         |           |        |            |          |      |               |          |     |       |      |
| Sola <mark>r gair</mark> | ns in watts, o             | alculate   | d for ea                                      | ch month   | <u>1</u> |         |           | (83)m  | = Sum(74)  | m(82     | )m   |               |          | _   |       |      |
| · · ·                    | 3.13 39.87                 | 55.83      | 71.3  | 81.81      |          | 32.07   | 78.77     | 70     | .8 61.1    | 7 44     | .41  | 27.79         | 19.74    |     |       | (83) |
|                          | ns – internal              |            | <u>,                                     </u> |            | Ť        |         |           |        |            |          |      |               |          | _   |       |      |
| (84)m= 35                | 54.37 368.92               | 374.29     | 373.23  | 367.39     | 3        | 51.99   | 338.67    | 336    | .05 335.1  | 2 335    | 5.07 | 337.35        | 343.05   | 5   |       | (84) |
| 7. Mean                  | internal tem               | perature   | e (heatir                                     | ig seasoi  | า)       |         |           |        |            |          |      |               |          |     |       |      |
| Tempera                  | ature during               | heating    | periods                                       | in the liv | ing      | area fr | rom Tab   | ole 9  | Th1 (°C)   |          |      |               |          |     | 21    | (85) |
| Utilisatio               | on factor for g            | gains for  | living a                                      | rea, h1,n  | n (s     | ee Tat  | ole 9a)   |        |            |          |      | -             |          | _   |       |      |
| <u> </u>                 | Jan Feb                    | Mar        | Apr   | May        |          | Jun     | Jul       | A      | ug Se      | p C      | Oct  | Nov           | Dec      | ;   |       |      |
| (86)m= (                 | 0.99 0.99                  | 0.97       | 0.93  | 0.82       | (        | 0.61    | 0.44      | 0.4    | 6 0.69     | 0.       | 91   | 0.98          | 0.99     |     |       | (86) |
| Mean in                  | ternal tempe               | rature in  | living a                                      | irea T1 (f | ollo     | w step  | os 3 to 7 | 7 in T | able 9c)   |          |      |               |          |     |       |      |
| (87)m= 2                 | 0.54 20.61                 | 20.72      | 20.86   | 20.96      |          | 21      | 21        | 2      | 1 20.9     | 9 20     | ).9  | 20.71         | 20.52    |     |       | (87) |
| Tempera                  | ature during               | heating    | periods                                       | in rest of | fdw      | velling | from Ta   | able 9 | 9, Th2 (°C | ;)       |      | ·             |          |     |       |      |
| · ·                      | 0.36 20.36                 | 20.37      | 20.37   | 20.37      | -        | 20.38   | 20.38     | 20.    | `          | <u> </u> | .37  | 20.37         | 20.37    |     |       | (88) |
| Utilisatio               | n factor for g             | nains for  | rest of                                       | dwelling   | h2       | .m (se  | e Table   | 9a)    | I          |          |      |               |          |     |       |      |
|                          | 0.99 0.98                  | 0.97       | 0.91  | 0.78       |          | 0.55    | 0.38      | 0.4    | 4 0.63     | 0.       | 89   | 0.97          | 0.99     | ٦   |       | (89) |
|                          |                            | -l         |   | t of dwol  | lina     | T2 (fo  | llow etc  |        |            |          | -)   | 1             | L        |     |       |      |
|                          | ternal tempe<br>9.75 19.85 | 20.02      | 20.22   | 20.34      | <u> </u> | 12 (10  | 20.38     | 20.    | 1          | 1        | .27  | 20            | 19.73    | ٦   |       | (90) |
|                          | 13.05                      | 20.02      | 1 20.22                                       | 20.04      |          | 0.00    | 20.00     | 20.    | 20.3       |          |      | ing area ÷ (4 |          | ╀   | 0.51  | (91) |
|                          |                            |            |   |            |          |         |           |        |            |          |      | g             | <b>'</b> | L   | 0.01  |      |

| Mean     | interna   | l temper  | ature (fo                           | r the wh              | ole dwe   | lling) = fl | LA x T1                | + (1 – fL | .A) × T2        |                       |              |             |           |        |
|----------|-----------|-----------|-------------------------------------|-----------------------|-----------|-------------|------------------------|-----------|-----------------|-----------------------|--------------|-------------|-----------|--------|
| (92)m=   | 20.15     | 20.24     | 20.37                               | 20.54                 | 20.65     | 20.69       | 20.69                  | 20.7      | 20.69           | 20.59                 | 20.36        | 20.13       |           | (92)   |
|          |           | 1         | 1                                   |                       | -         | i           | m Table                | 4e, whe   | · · ·           | opriate               |              |             |           |        |
| (93)m=   | 20.15     | 20.24     | 20.37                               | 20.54                 | 20.65     | 20.69       | 20.69                  | 20.7      | 20.69           | 20.59                 | 20.36        | 20.13       |           | (93)   |
|          |           |           | uirement                            |                       |           |             |                        |           |                 | · ۲' ۰۰ /             | 70)          |             | la ta     |        |
|          |           |           | ernal ter                           |                       |           | ied at ste  | ep 11 of               | I able 9  | o, so tha       | t I I,m=(             | 76)m an      | d re-calc   | ulate     |        |
|          | Jan       | Feb       | Mar                                 | Apr                   | May       | Jun         | Jul                    | Aug       | Sep             | Oct                   | Nov          | Dec         |           |        |
| Utilisa  | ation fac | tor for g | ains, hm                            | :                     |           |             |                        |           |                 |                       |              |             |           |        |
| (94)m=   | 0.99      | 0.98      | 0.97                                | 0.92                  | 0.79      | 0.58        | 0.41                   | 0.43      | 0.66            | 0.9                   | 0.97         | 0.99        |           | (94)   |
|          | -         |           | , W = (94                           | · · ·                 | ,         | 00400       | 400.44                 |           |                 | 000 70                | 000.04       | 000.07      |           | (05)   |
| (95)m=   | 350.45    | 362.48    | 361.57                              | 342.05                | 291.71    | 204.92      | 138.44                 | 144.84    | 220.88          | 300.76                | 328.81       | 339.97      |           | (95)   |
| (96)m=   | 4.3       | 4.9       | ernal tem<br>6.5                    | 8.9                   | 11.7      | 14.6        | 16.6                   | 16.4      | 14.1            | 10.6                  | 7.1          | 4.2         |           | (96)   |
|          |           |           |                                     |                       |           |             | =[(39)m :              |           |                 |                       |              |             |           |        |
| (97)m=   | 553.18    | 533.93    | 481.88                              | 399.63                | 306.59    | 206.06      | 138.5                  | 144.93    | 223.86          | 341.94                | 456.08       | 550.72      |           | (97)   |
| Space    | e heatin  | g require | ement fo                            | r each m              | nonth, k  | Nh/mont     | th = 0.02              | 24 x [(97 | )m – (95        | )m] x (4 <sup>-</sup> | 1)m          |             |           |        |
| (98)m=   | 150.83    | 115.22    | 89.51                               | 41.46                 | 11.07     | 0           | 0                      | 0         | 0               | 30.64                 | 91.64        | 156.8       |           | _      |
|          |           |           |                                     |                       |           |             |                        | Tota      | l per year      | (kWh/year             | ') = Sum(9   | 8)15,912 =  | 687.17    | (98)   |
| Space    | e heatin  | g require | ement in                            | kWh/m <sup>2</sup>    | /year     |             |                        |           |                 |                       |              |             | 13.29     | (99)   |
| 9b. En   | ergy red  | quiremer  | nts – Cor                           | nmu <mark>nity</mark> | heating   | scheme      | ;                      |           |                 |                       |              |             |           |        |
|          |           |           |                                     |                       |           |             | ater heat<br>heating ( |           |                 |                       | unity sch    | neme.       | 0         | (301)  |
| Fractio  | n of spa  | ace heat  | from co                             | mmunity               | system    | 1 – (301    | 1) =                   |           |                 |                       |              |             | 1         | (302)  |
|          |           |           |                                     |                       |           |             | procedure              |           |                 | ip to four o          | other heat   | sources; ti | he latter |        |
|          |           |           | s, geother <mark>r</mark><br>Commun |                       |           | rom powel   | r stations.            | See Appel | ndi <u>x C.</u> |                       |              |             | 1         | (303a) |
| Fractio  | n of tota | al space  | heat from                           | m Comn                | nunity he | eat pump    | C                      |           |                 | (3                    | 02) x (303   | a) =        | 1         | (304a) |
| Factor   | for cont  | trol and  | charging                            | method                | (Table    | 4c(3)) fo   | r commu                | unity hea | ating syst      | tem                   |              |             | 1         | (305)  |
| Distrib  | ution los | ss factor | (Table 1                            | 2c) for c             | ommun     | ity heatir  | ng syste               | m         |                 |                       |              |             | 1         | (306)  |
| Space    | heating   | g         |                                     |                       |           |             |                        |           |                 |                       |              |             | kWh/year  | ,      |
| Annua    | l space   | heating   | requirem                            | nent                  |           |             |                        |           |                 |                       |              |             | 687.17    |        |
| Space    | heat fro  | om Comi   | munity h                            | eat pum               | þ         |             |                        |           | (98) x (30      | )4a) x (30            | 5) x (306) = | -           | 687.17    | (307a) |
| Efficier | ncy of s  | econdar   | y/supple                            | mentary               | heating   | system      | in % (fro              | om Table  | e 4a or A       | ppendix               | E)           |             | 0         | (308   |
| Space    | heating   | require   | ment froi                           | m secon               | dary/su   | oplemen     | tary syst              | em        | (98) x (30      | )1) x 100 -           | ÷ (308) =    |             | 0         | (309)  |
|          | heating   |           | equirem                             | ont                   |           |             |                        |           |                 |                       |              |             | 4040 50   | 7      |
|          |           | -         | ty schem                            |                       |           |             |                        |           |                 |                       |              |             | 1816.58   |        |
|          |           |           | nunity he                           |                       | )         |             |                        |           | (64) x (30      | )3a) x (30            | 5) x (306) = | =           | 1816.58   | (310a) |
| Electric | city use  | d for hea | at distribu                         | ution                 |           |             |                        | 0.01      | × [(307a).      | (307e) +              | (310a)(      | 310e)] =    | 25.04     | (313)  |
| Cooling  | g Syste   | m Energ   | y Efficiei                          | ncy Ratio             | C         |             |                        |           |                 |                       |              |             | 0         | (314)  |
| Space    | cooling   | (if there | is a fixe                           | d cooling             | g systen  | n, if not e | enter 0)               |           | = (107) ÷       | (314) =               |              |             | 0         | (315)  |

| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside                                     | 121.42                   | (330a) |
|--|--------------------------|--------|
| warm air heating system fans   | 0                        | (330b) |
| pump for solar water heating   | 0                        | (330g) |
| Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =  | 121.42                   | (331)  |
| Energy for lighting (calculated in Appendix L)   | 318.91                   | (332)  |
| Electricity generated by PVs (Appendix M) (negative quantity)  | -664.99                  | (333)  |
| Electricity generated by wind turbine (Appendix M) (negative quantity)   | 0                        | (334)  |
| 12b. CO2 Emissions – Community heating scheme  |                          |        |
| Energy Emission factor<br>kWh/year kg CO2/kWh  | Emissions<br>kg CO2/year |        |
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel | 364                      | (367a) |
| CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x 0.52 =  | 356.99                   | (367)  |
| Electrical energy for heat distribution [(313) x 0.52  | 12.99                    | (372)  |
| Total CO2 associated with community systems (363)(366) + (368)(372)  | 369.98                   | (373)  |
| CO2 associated with space heating (secondary) (309) x 0  | = 0                      | (374)  |
| CO2 associated with water from immersion heater or instantaneous heater (312) × 0.52 =   | - 0                      | (375)  |
| Total CO2 associated with space and water heating (373) + (374) + (375) =  | 369.98                   | (376)  |
| CO2 associated with electricity for pumps and fans within dwelling (331)) × 0.52 =   | 63.02                    | (378)  |
| CO2 associated with electricity for lighting (332))) x 0.52  | 165.52                   | (379)  |
| Energy saving/generation technologies (333) to (334) as applicable           Item 1         0.52         x 0.01 =  | -345.13                  | (380)  |
| Total CO2, kg/year sum of (376)(382) =   | 253.39                   | (383)  |
| Dwelling CO2 Emission Rate (383) ÷ (4) =   | 4.9                      | (384)  |
| El rating (section 14)   | 96.49                    | (385)  |

|   |                             |                         | User D                                | etails:      |             |                 |                       |          |  |      |
|---|-----------------------------|-------------------------|---------------------------------------|--------------|-------------|-----------------|-----------------------|----------|--|------|
| Assessor Name:<br>Software Name:                              | Stroma FSAP 201             |                         |                                       | Versio       | n: 1.0.4.23 |                 |                       |          |  |      |
| Address :   | 2 Bed Flat, 219-223         |                         |                                       | Address:     |             | nh lunct        | ion I ON              |          |  |      |
| 1. Overall dwelling dimer                                     | •                           | Columan                 |                                       | ne, Loug     | προιοαί     | gri Junci       |                       |          |  |      |
| Ground floor  |                             |                         | Area<br>8                             |              | (1a) x      | <b>Av. He</b>   | <b>ight(m)</b><br>2.5 | (2a) =   | <b>Volume(m<sup>3</sup>)</b><br>211.75 | (3a) |
| Total floor area TFA = (1a                                    | )+(1b)+(1c)+(1d)+(1e        | )+(1n)                  | 8                                     | 4.7          | (4)         |                 |                       |          |  |      |
| Dwelling volume   |                             |                         |                                       |              | (3a)+(3b)   | +(3c)+(3d       | l)+(3e)+              | .(3n) =  | 211.75                                 | (5)  |
| 2. Ventilation rate:  |                             |                         |                                       |              |             |                 |                       |          |  |      |
| Number of chimneys  |                             | econdary<br>eating<br>0 | , , , , , , , , , , , , , , , , , , , | other<br>0   | ] = [       | <b>total</b>    | × 4                   | 40 =     | m <sup>3</sup> per hour                | (6a) |
| Number of open flues  | 0 +                         | 0                       | ] + [                                 | 0            | ] = [       | 0               | x 2                   | 20 =     | 0                                      | (6b) |
| Number of intermittent fan                                    | s                           |                         | J L_                                  |              |             | 0               | x 1                   | 10 =     | 0                                      | (7a) |
| Number of passive vents                                       |                             |                         |                                       |              | Ē           | 0               | x 1                   | 10 =     | 0                                      | (7b) |
| Number of flueless gas fire                                   | es                          |                         |                                       |              |             | 0               | x 4                   | 40 =     | 0                                      | (7c) |
|   |                             |                         |                                       |              |             |                 |                       | Air ch   | ange <mark>s per</mark> ho             | ur   |
| Infiltration due to chimney                                   |                             |                         |                                       |              | Ę           | 0               |                       | ÷ (5) =  | 0                                      | (8)  |
| If a pressurisation test has be<br>Number of storeys in the   |                             | ed, proceed             | to (17), o                            | otherwise c  | ontinue fro | om (9) to (     |                       |          | 0                                      | (9)  |
| Additional infiltration                                       | ) – fan ete el en timb en f |                         | 0.05 (                                |              |             |                 | [(9)-                 | 1]x0.1 = | 0                                      | (10) |
| Structural infiltration: 0.2<br>if both types of wall are pre | sent, use the value corres  |                         |                                       |              | •           | uction          |                       | l        | 0                                      | (11) |
| deducting areas of opening                                    |                             | ed) or 0.1              | l (seale                              | d), else     | enter 0     |                 |                       | [        | 0                                      | (12) |
| If no draught lobby, ente                                     | er 0.05, else enter 0       |                         |                                       |              |             |                 |                       |          | 0                                      | (13) |
| Percentage of windows   | and doors draught st        | ripped                  |                                       |              |             |                 |                       |          | 0                                      | (14) |
| Window infiltration   |                             |                         | (                                     | 0.25 - [0.2  | x (14) ÷ 1  | = [00           |                       |          | 0                                      | (15) |
| Infiltration rate   |                             |                         |                                       | (8) + (10) - |             |                 |                       |          | 0                                      | (16) |
| Air permeability value, c                                     |                             |                         | •                                     | •            |             | etre of e       | nvelope               | area     | 2                                      | (17) |
| If based on air permeabilit                                   | -                           |                         |                                       |              |             | :- <b>b</b> - : |                       |          | 0.1                                    | (18) |
| Air permeability value applies<br>Number of sides sheltered   |                             | i been done             | e or a deg                            | ree all per  | meability   | is being us     | seu                   | I        | 0                                      | (19) |
| Shelter factor  |                             |                         |                                       | (20) = 1 - [ | 0.075 x (1  | 9)] =           |                       |          | 1                                      | (20) |
| Infiltration rate incorporation                               | ng shelter factor           |                         |                                       | (21) = (18)  | x (20) =    |                 |                       |          | 0.1                                    | (21) |
| Infiltration rate modified fo                                 | r monthly wind speed        |                         |                                       |              |             |                 |                       | I        |  |      |
| Jan Feb M   | /lar Apr May                | Jun                     | Jul                                   | Aug          | Sep         | Oct             | Nov                   | Dec      |  |      |
| Monthly average wind spe                                      | ed from Table 7             |                         |                                       |              |             |                 |                       |          |  |      |
| (22)m= 5.1 5 4  | .9 4.4 4.3                  | 3.8                     | 3.8                                   | 3.7          | 4           | 4.3             | 4.5                   | 4.7      |  |      |
| Wind Factor (22a)m = (22                                      | )m ÷ 4                      |                         |                                       |              |             |                 |                       |          |  |      |
| (22a)m= 1.27 1.25 1   | .23 1.1 1.08                | 0.95                    | 0.95                                  | 0.92         | 1           | 1.08            | 1.12                  | 1.18     |  |      |

| Adjuste  | ed infiltra            | ation rat                       | e (allow   | ing for sl                  | nelter an    | d wind s       | peed) =            | = (21a) x      | (22a)m       |                   |                       |                   |              |               |
|----------|------------------------|---------------------------------|------------|-----------------------------|--------------|----------------|--------------------|----------------|--------------|-------------------|-----------------------|-------------------|--------------|---------------|
|          | 0.13                   | 0.12                            | 0.12       | 0.11                        | 0.11         | 0.1            | 0.1                | 0.09           | 0.1          | 0.11              | 0.11                  | 0.12              |              |               |
|          |                        | c <i>tive air</i><br>al ventila | -          | rate for t                  | he appli     | cable ca       | se                 |                |              |                   |                       |                   |              | - (220)       |
|          |                        |                                 |            | endix N (2                  | (23a) = (23a | a) x Emv (e    | equation (         | N5)), othe     | rwise (23h   | (23a) = (23a)     |                       |                   | 0.8          |               |
|          |                        | • •                             | 0 11       | . (                         | , (          | , ,            |                    | m Table 4h     | ,            | <i>,)</i> = (200) |                       |                   | 0.8          |               |
|          |                        |                                 |            |                             | Ū            |                | ,                  | HR) (24a       | ,            | 2h)m + ('         | 23h) v [ <sup>.</sup> | 1 – (23c)         | 73.          | 1 (230)       |
| (24a)m=  |                        | 0.26                            | 0.26       | 0.24                        | 0.24         | 0.23           | 0.23               | 0.23           | 0.23         | 0.24              | 0.25                  | 0.25              | ]<br>]       | (24a)         |
| · · ·    |                        |                                 |            |                             |              |                |                    | MV) (24b       |              |                   |                       |                   | J            |               |
| (24b)m=  | 0                      | 0                               |            | 0                           | 0            | 0              | 0                  | 0              | 0            | 0                 | 0                     | 0                 | 1            | (24b)         |
| · · ·    | whole h                | use ex                          | tract ver  | ntilation of                | r positiv    | input v        | ı<br>ventilati     | on from o      | L<br>outside |                   |                       |                   | J            |               |
| ,        |                        |                                 |            |                             | •            | •              |                    | lc) = (22k     |              | .5 × (23b         | )                     |                   |              |               |
| (24c)m=  | 0                      | 0                               | 0          | 0                           | 0            | 0              | 0                  | 0              | 0            | 0                 | 0                     | 0                 | ]            | (24c)         |
| ,        |                        |                                 |            |                             | •            | •              |                    | on from I      |              | _                 |                       |                   | -            |               |
|          | · ·                    | ,                               | r <u>`</u> | r È                         | ŕ            | , `            | , <u> </u>         | 0.5 + [(2      | r            | <u> </u>          |                       | <u> </u>          | 1            |               |
| (24d)m=  |                        | 0                               | 0          | 0                           | 0            | 0              | 0                  | 0              | 0            | 0                 | 0                     | 0                 |              | (24d)         |
|          |                        |                                 | î .        | <u> </u>                    | í .          | ŕ              | , <u>,</u>         | 1d) in box     | 1 /          | 0.04              | 0.05                  | 0.05              | 1            | (05)          |
| (25)m=   | 0.26                   | 0.26                            | 0.26       | 0.24                        | 0.24         | 0.23           | 0.23               | 0.23           | 0.23         | 0.24              | 0.25                  | 0.25              | J            | (25)          |
| 3. Hea   | at l <mark>osse</mark> | s and he                        | eat loss   | paramet                     | er:          |                |                    |                |              |                   |                       |                   |              |               |
| ELEN     |                        | Gros<br>area                    |            | Openin<br>m                 |              | Net Ar<br>A ,r |                    | U-valı<br>W/m2 |              | A X U<br>(W/ł     | <)                    | k-value<br>kJ/m²· |              | A X k<br>kJ/K |
| Window   | ws Type                | e 1                             |            |                             |              | 8.91           | x1                 | /[1/( 0.73 )-  | + 0.04] =    | 6.32              |                       |                   |              | (27)          |
| Windov   | ws Type                | 2                               |            |                             |              | 1.28           | X                  | /[1/( 0.73 )-  | + 0.04] =    | 0.91              |                       |                   |              | (27)          |
| Windov   | ws Type                | 93                              |            |                             |              | 11.02          | 5 <mark>x</mark> 1 | /[1/( 0.73 )-  | + 0.04] =    | 7.82              |                       |                   |              | (27)          |
| Windov   | ws Type                | e 4                             |            |                             |              | 7.2            | اx                 | /[1/( 0.73 )-  | + 0.04] =    | 5.11              |                       |                   |              | (27)          |
| Window   | ws Type                | e 5                             |            |                             |              | 3.15           | ۲x                 | /[1/( 0.73 )-  | + 0.04] =    | 2.23              |                       |                   |              | (27)          |
| Walls 7  | Гуре1                  | 27                              | ,          | 8.91                        |              | 18.09          | ) x                | 0.15           | =            | 2.71              | ] [                   |                   |              | (29)          |
| Walls 7  | Гуре2                  | 32.                             | 5          | 1.28                        | 3            | 31.22          | <u>x</u>           | 0.15           | =            | 4.68              | ז ר                   |                   | = F          | (29)          |
| Walls 7  | ГуреЗ                  | 14.                             | 5          | 11.0                        | 2            | 3.48           | x                  | 0.15           | =            | 0.52              | ז ר                   |                   | = F          | (29)          |
| Walls 7  | Гуре4                  | 22                              | 2          | 3.15                        | 5            | 18.85          | 5 X                | 0.15           | =            | 2.83              | i F                   |                   | ΞĒ           | (29)          |
| Walls 7  | Гуре5                  | 9                               |            | 7.2                         |              | 1.8            | x                  | 0.15           |              | 0.27              | i F                   |                   | ΞĒ           | (29)          |
| Roof     |                        | 84.                             | 7          | 0                           |              | 84.7           | x                  | 0.11           |              | 9.32              | i F                   |                   | ΞĒ           | (30)          |
| Total a  | rea of e               | lements                         | s, m²      |                             |              | 189.7          | ,                  |                |              |                   |                       |                   |              | (31)          |
| Party v  | vall                   |                                 |            |                             |              | 17.5           | ×                  | 0              | =            | 0                 |                       |                   |              | (32)          |
| Party fl | loor                   |                                 |            |                             |              | 84.7           |                    | L              | 1            |                   |                       |                   |              | (32a)         |
| -        | ernal wall **          |                                 |            |                             |              | 126.5          |                    |                |              |                   | L<br>[                |                   | $\dashv$     | (32c)         |
|          |                        |                                 |            | effective wi<br>nternal wal |              | alue calcul    |                    | g formula 1    | /[(1/U-valu  | ıe)+0.04] a       | L<br>Is given in      | paragrapl         | ш Ц<br>h 3.2 |               |

| Fabric heat loss, $W/K = S (A \times U)$                             | (26)(30) + (32) =               | 42.72   | (33) |
|--|---------------------------------|---------|------|
| Heat capacity $Cm = S(A \times k)$                                   | ((28)(30) + (32) + (32a)(32e) = | 14177.7 | (34) |
| Thermal mass parameter (TMP = $Cm \div TFA$ ) in kJ/m <sup>2</sup> K | Indicative Value: Medium        | 250     | (35) |
|  |                                 |         |      |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

| can be ı                         | used inste   | ad of a dei           | tailed calc | ulation.                 |             |             |             |   |            |                           |                         |         |         |      |
|----------------------------------|--|-----------------------|-------------|--------------------------|-------------|-------------|-------------|---|------------|---------------------------|-------------------------|---------|---------|------|
| Therm                            | hermal bridges : S (L x Y) calculated using Appendix K |                       |             |                          |             |             |             |   |            |                           |                         |         |         | (36) |
| if details                       | of therma  | al bridging           | are not kri | nown (36) =              | = 0.05 x (3 | 1)          |             |   |            |                           |                         |         |         |      |
| Total f                          | abric he   | at loss               |             |                          |             |             |             |   | (33) +     | (36) =                    |                         |         | 58.35   | (37) |
| Ventila                          | ation hea  | at loss ca            | alculated   | monthly                  | Ý           |             | -           |   | (38)m      | = 0.33 × (                | (25)m x (5)             | -       | _       |      |
|                                  | Jan  | Feb                   | Mar         | Apr                      | May         | Jun         | Jul         | Aug   | Sep        | Oct                       | Nov                     | Dec     |         |      |
| (38)m=                           | 18.31  | 18.13                 | 17.96       | 17.09                    | 16.91       | 16.04       | 16.04       | 15.86   | 16.39      | 16.91                     | 17.26                   | 17.61   |         | (38) |
| Heat ti                          | ransfer o  | coefficier            | nt, W/K     |                          |             |             |             |   | (39)m      | = (37) + (                | 38)m                    |         |         |      |
| (39)m=                           | 76.66  | 76.49                 | 76.31       | 75.44                    | 75.26       | 74.39       | 74.39       | 74.22   | 74.74      | 75.26                     | 75.61                   | 75.96   |         |      |
|                                  |  |                       |             | / 01/                    |             |             |             |   |            | -                         | Sum(39)1.               | 12 /12= | 75.4    | (39) |
|                                  | <u> </u>   | meter (H              | ,<br>1      | i                        |             |             |             |   |            | = (39)m ÷                 |                         |         | 1       |      |
| (40)m=                           | 0.91   | 0.9                   | 0.9         | 0.89                     | 0.89        | 0.88        | 0.88        | 0.88  | 0.88       | 0.89                      | 0.89                    | 0.9     |         |      |
| Numbe                            | er of day  | /s in moi             | nth (Tab    | le 1a)                   |             |             |             |   | ,          | Average =                 | : Sum(40)₁.             | 12 /12= | 0.89    | (40) |
|                                  | Jan  | Feb                   | Mar         | Apr                      | May         | Jun         | Jul         | Aug   | Sep        | Oct                       | Nov                     | Dec     |         |      |
| (41)m=                           | 31   | 28                    | 31          | 30                       | 31          | 30          | 31          | 31  | 30         | 31                        | 30                      | 31      |         | (41) |
|                                  |  |                       |             | !                        |             |             |             | <u>.                                    </u>  |            |                           | ļ                       |         | 1       |      |
| 4 W/2                            | ater hea   | ting ener             | rav reau    | irement <sup>.</sup>     |             |             |             |   |            |                           |                         | kWh/ye  | ear:    |      |
|                                  |  |                       | gy loqu     |                          |             |             |             |   |            |                           |                         |         |         |      |
|                                  |  | ipancy, I             |             | . 14                     | ( 0 0000    | ио (тг      | - 40 0      |   | 040/       |                           |                         | 55      |         | (42) |
|                                  | A > 13.  |                       | + 1.76 x    | li - exp                 | (-0.0003    | 549 X (11   | -A -13.9    | )2)] + 0.0  | JU13 X (   | IFA -13.                  | .9)                     |         |         |      |
|                                  |  |                       | ater usag   | ge in <mark>litre</mark> | es per da   | ay Vd,av    | erage =     | (25 x N)  | + 36       |                           | 94                      | .67     | 1       | (43) |
|                                  |  |                       |             |                          |             | -           | 7           | to achieve  | a water us | se ta <mark>rget</mark> o | of                      |         |         |      |
| not more                         | e that 125   | litres per p          | berson pel  | r day (all w             | ater use, I | not and co  |             |   |            |                           |                         |         |         |      |
|                                  | Jan  | Feb                   | Mar         | Apr                      | May         | Jun         | Jul         | Aug   | Sep        | Oct                       | Nov                     | Dec     |         |      |
| Hot wat                          | er usage i   | n litres per          | day for ea  | ach month                | Vd,m = fa   | ctor from   | Table 1c x  | (43)  |            |                           |                         |         |         |      |
| (44)m=                           | 104.13   | 100.35                | 96.56       | 92.77                    | 88.99       | 85.2        | 85.2        | 88.99   | 92.77      | 96.56                     | 100.35                  | 104.13  |         |      |
| Enorm                            | contont of   | bot wator             | used cal    | loulated m               | onthly - 1  | 100 v Vd r  | m v nm v [  | )<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>)<br>) |            |                           | $m(44)_{112} =$         |         | 1136.02 | (44) |
|                                  |  |                       |             | <b></b>                  | -           |             | r           | <b></b>   |            | -                         | -                       |         | 1       |      |
| (45)m=                           | 154.43   | 135.06                | 139.37      | 121.51                   | 116.59      | 100.61      | 93.23       | 106.98  | 108.26     | 126.17                    | 137.72                  | 149.56  |         |      |
| lf instan                        | taneous w  | vater heatii          | ng at point | t of use (no             | hot water   | r storage), | enter 0 in  | boxes (46,  |            | l otal = Su               | Im(45) <sub>112</sub> = | =       | 1489.5  | (45) |
| (46)m=                           | 23.16  | 20.26                 | 20.91       | 18.23                    | 17.49       | 15.09       | 13.98       | 16.05   | 16.24      | 18.93                     | 20.66                   | 22.43   | 1       | (46) |
| · · ·                            | storage  |                       | 20.01       | 10.20                    | 17.45       | 10.00       | 10.00       | 10.00   | 10.24      | 10.00                     | 20.00                   | 22.40   | J       | (10) |
| Storag                           | e volum  | e (litres)            | includir    | ng any so                | olar or W   | /WHRS       | storage     | within sa   | me ves     | sel                       |                         | 180     | ]       | (47) |
| If com                           | munity h   | eating a              | ind no ta   | ank in dw                | velling, e  | nter 110    | ) litres in | (47)  |            |                           |                         |         |         |      |
| Otherv                           | vise if no   | o stored              | hot wate    | er (this in              | icludes i   | nstantar    | neous co    | ombi boil   | ers) ente  | er '0' in (               | (47)                    |         |         |      |
|                                  | storage  |                       |             |                          |             |             |             |   |            |                           |                         |         |         |      |
| a) If m                          | nanufact   | urer's de             | eclared I   | oss facto                | or is kno   | wn (kWł     | n/day):     |   |            |                           |                         | 0       |         | (48) |
| Temperature factor from Table 2b |  |                       |             |                          |             |             |             |   |            |                           |                         | ]       | (49)    |      |
|                                  |  |                       | -           | e, kWh/ye                |             |             |             | (48) x (49)   | =          |                           | 18                      | 80      | ]       | (50) |
|                                  |  |                       |             | cylinder l               |             |             |             |   |            |                           |                         |         | 1       |      |
|                                  |  | age loss<br>leating s |             | rom Tabl<br>on 4-3       | е∠(КVV      | n/iitre/da  | ay)         |   |            |                           | 0.                      | 01      | J       | (51) |
|                                  | •  | from Tal              |             | 0.10                     |             |             |             |   |            |                           | 0                       | 87      | 1       | (52) |
|                                  |  | actor fro             |             | 2b                       |             |             |             |   |            |                           |                         | .6      |         | (52) |
|                                  |  |                       |             |                          |             |             |             |   |            |                           | -                       |         |         |      |

|                      | nergy lost from water storage, kWh/year<br>nter (50) or (54) in (55) |            |                |            |                       |             |             | (47) x (51)  | ) x (52) x (             | 53) =                     |             | .97<br>.97            |              | (54)<br>(55) |
|----------------------|--|------------|----------------|------------|-----------------------|-------------|-------------|--------------|--------------------------|---------------------------|-------------|-----------------------|--------------|--------------|
| Water                | storage  | loss cal   | culated        | for each   | month                 |             |             | ((56)m = (   | 55) × (41)               | m                         | L           |                       |              |              |
| (56)m=               | 30.09  | 27.18      | 30.09          | 29.12      | 30.09                 | 29.12       | 30.09       | 30.09        | 29.12                    | 30.09                     | 29.12       | 30.09                 |              | (56)         |
| If cylinde           | er contain   | s dedicate | d solar sto    | nage, (57) | <b>i</b><br>m = (56)m | x [(50) – ( | H11)] ÷ (5  | 0), else (5  | 7)m = (56)               | m where (                 | H11) is fro | m Append              | l<br>ix H    |              |
| (57)m=               | 30.09  | 27.18      | 30.09          | 29.12      | 30.09                 | 29.12       | 30.09       | 30.09        | 29.12                    | 30.09                     | 29.12       | 30.09                 |              | (57)         |
| Primar               | y circuit  | loss (ar   | nnual) fro     | om Table   | e 3                   |             |             |              |                          |                           |             | 0                     |              | (58)         |
| Primar               | y circuit  | loss cal   | culated        | for each   | month (               | 59)m = (    | (58) ÷ 36   | 65 × (41)    | m                        |                           |             |                       |              |              |
| (mo                  |  | factor f   | rom Tab        | le H5 if t | here is s             | solar wat   | ter heatir  | -            | cylinde                  |                           | stat)       | 1                     | 1            |              |
| (59)m=               | 23.26  | 21.01      | 23.26          | 22.51      | 23.26                 | 22.51       | 23.26       | 23.26        | 22.51                    | 23.26                     | 22.51       | 23.26                 |              | (59)         |
| Combi                | loss ca  | lculated   | for each       | month      | (61)m =               | (60) ÷ 30   | 65 × (41)   | )m           | -                        |                           | -           | -                     |              |              |
| (61)m=               | 0  | 0          | 0              | 0          | 0                     | 0           | 0           | 0            | 0                        | 0                         | 0           | 0                     |              | (61)         |
| Total h              | neat req   | uired for  | water h        | eating ca  | alculated             | for eac     | h month     | (62)m =      | 0.85 × (                 | (45)m +                   | (46)m +     | (57)m +               | (59)m + (61) | m            |
| (62)m=               | 207.78   | 183.25     | 192.73         | 173.14     | 169.95                | 152.24      | 146.58      | 160.34       | 159.89                   | 179.52                    | 189.35      | 202.91                |              | (62)         |
| Solar D              | HW input   | calculated | using App      | endix G o  | r Appendix            | H (negati   | ve quantity | v) (enter '0 | ' if no sola             | r contribut               | ion to wate | er heating)           |              |              |
| (add a               | dditiona   | l lines if | FGHRS          | and/or \   | NWHRS                 | applies     | , see Ap    | pendix (     | G)                       |                           |             | -                     |              |              |
| (63)m=               | 0  | 0          | 0              | 0          | 0                     | 0           | 0           | 0            | 0                        | 0                         | 0           | 0                     |              | (63)         |
| Output               | t from w   | ater hea   | ter            |            |                       |             |             |              |                          |                           |             |                       |              |              |
| (64)m=               | 207.78   | 183.25     | 192.73         | 173.14     | 169.95                | 152.24      | 146.58      | 160.34       | 159.89                   | 179.52                    | 189.35      | 202.91                |              |              |
|                      |  |            |                |            |                       |             |             | Outp         | out from wa              | ater heate                | r (annual)₁ | 12                    | 2117.69      | (64)         |
| Hea <mark>t g</mark> | jains fro  | m water    | heating        | , kWh/m    | onth 0.2              | 5 [0.85     | × (45)m     | + (61)m      | 1 <mark>] +</mark> 0.8 > | ( <mark>46)m</mark> (     | + (57)m     | + ( <mark>59)m</mark> | ]            |              |
| (65)m=               | 94.03  | 83.46      | 89.02          | 81.71      | 81.45                 | 74.76       | 73.68       | 78.25        | 77.3                     | 84.63                     | 87.1        | 9 <mark>2.41</mark>   |              | (65)         |
| inclu                | ude (57)   | m in calo  | culation       | of (65)m   | only if c             | ylinder i   | s in the o  | dwelling     | or hot w                 | ate <mark>r is f</mark> r | om com      | munity h              | eating       |              |
| 5. Int               | ternal ga  | ains (see  | e Table 5      | 5 and 5a   | ):                    |             |             |              |                          |                           |             |                       |              |              |
| Metab                | <u>olic gair</u>   | is (Table  | <u>5), Wat</u> | ts         |                       |             |             |              |                          |                           |             | -                     |              |              |
|                      | Jan  | Feb        | Mar            | Apr        | May                   | Jun         | Jul         | Aug          | Sep                      | Oct                       | Nov         | Dec                   |              |              |
| (66)m=               | 127.3  | 127.3      | 127.3          | 127.3      | 127.3                 | 127.3       | 127.3       | 127.3        | 127.3                    | 127.3                     | 127.3       | 127.3                 |              | (66)         |
| Lightin              | ig gains   | (calcula   | ted in Ap      | opendix    | L, equat              | ion L9 o    | r L9a), a   | lso see      | Table 5                  |                           | -           | _                     |              |              |
| (67)m=               | 26.77  | 23.78      | 19.34          | 14.64      | 10.94                 | 9.24        | 9.98        | 12.98        | 17.42                    | 22.12                     | 25.81       | 27.52                 |              | (67)         |
| Applia               | nces ga  | ins (calc  | ulated ir      | n Appeno   | dix L, eq             | uation L    | 13 or L1    | 3a), also    | o see Ta                 | ble 5                     |             |                       | _            |              |
| (68)m=               | 228.98   | 231.36     | 225.37         | 212.62     | 196.53                | 181.41      | 171.31      | 168.93       | 174.92                   | 187.66                    | 203.76      | 218.88                |              | (68)         |
| Cookir               | ng gains   | (calcula   | ted in A       | ppendix    | L, equa               | tion L15    | or L15a)    | , also se    | ee Table                 | 5                         |             |                       | _            |              |
| (69)m=               | 35.73  | 35.73      | 35.73          | 35.73      | 35.73                 | 35.73       | 35.73       | 35.73        | 35.73                    | 35.73                     | 35.73       | 35.73                 |              | (69)         |
| Pumps                | s and fa   | ns gains   | (Table \$      | 5a)        |                       |             |             |              |                          |                           |             |                       |              |              |
| (70)m=               | 0  | 0          | 0              | 0          | 0                     | 0           | 0           | 0            | 0                        | 0                         | 0           | 0                     |              | (70)         |
| Losses               | s e.g. ev  | aporatic   | on (nega       | tive valu  | es) (Tab              | ole 5)      |             |              |                          |                           |             |                       |              |              |
| (71)m=               | -101.84  | -101.84    | -101.84        | -101.84    | -101.84               | -101.84     | -101.84     | -101.84      | -101.84                  | -101.84                   | -101.84     | -101.84               |              | (71)         |
| Water                | heating  | gains (T   | able 5)        |            |                       |             |             |              |                          |                           |             |                       |              |              |
| (72)m=               | 126.38   | 124.2      | 119.66         | 113.48     | 109.48                | 103.83      | 99.03       | 105.18       | 107.36                   | 113.75                    | 120.97      | 124.21                |              | (72)         |
| Total i              | internal   | gains =    | :              |            |                       | (66)        | m + (67)m   | i + (68)m +  | + (69)m + (              | (70)m + (7                | 1)m + (72)  | )m                    |              |              |
| (73)m=               | 443.33   | 440.53     | 425.56         | 401.94     | 378.14                | 355.67      | 341.52      | 348.28       | 360.89                   | 384.73                    | 411.73      | 431.8                 |              | (73)         |
| 6. So                | lar gains  | S:         | •              | •          | •                     | •           | •           |              | •                        |                           | •           | •                     |              |              |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation:  | Access Facto<br>Table 6d | r | Area<br>m² |   | Flux<br>Table 6a     |   | g_<br>Table 6b |   | FF<br>Table 6c |     | Gains<br>(W) |      |
|---------------|--------------------------|---|------------|---|----------------------|---|----------------|---|----------------|-----|--------------|------|
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 11.28                | × | 0.63           | x | 0.1            | ] = | 0.63         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 22.97                | x | 0.63           | x | 0.1            | =   | 1.28         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 41.38                | × | 0.63           | x | 0.1            | =   | 2.31         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 67.96                | x | 0.63           | x | 0.1            | =   | 3.8          | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 91.35                | x | 0.63           | x | 0.1            | =   | 5.1          | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 97.38                | x | 0.63           | x | 0.1            | =   | 5.44         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 91.1                 | x | 0.63           | x | 0.1            | =   | 5.09         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 72.63                | x | 0.63           | x | 0.1            | =   | 4.06         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 50.42                | x | 0.63           | x | 0.1            | =   | 2.82         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 28.07                | x | 0.63           | x | 0.1            | =   | 1.57         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 14.2                 | × | 0.63           | x | 0.1            | ] = | 0.79         | (75) |
| Northeast 0.9 | 0.77                     | x | 1.28       | x | 9.21                 | x | 0.63           | x | 0.1            | =   | 0.51         | (75) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 36.79                | x | 0.63           | x | 0.1            | =   | 5.06         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 62.67                | x | 0.63           | x | 0.1            | =   | 8.62         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 85.75                | × | 0.63           | x | 0.1            | =   | 11.79        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | × | 106.25               | х | 0.63           | х | 0.1            | =   | 14.61        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 119.01               | x | 0.63           | x | 0.1            | ] = | 16.37        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | х | 118.15               | × | 0.63           | x | 0.1            | =   | 16.25        | (77) |
| Southeast 0.9 | ( 0.7 <mark>7</mark>     | x | 3.15       | x | 113.91               | x | 0.63           | x | 0.1            | =   | 15.67        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 104.3 <mark>9</mark> | x | 0.63           | x | 0.1            | =   | 14.36        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 92.85                | × | 0.63           | x | 0.1            | =   | 12.77        | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 69.27                | × | 0.63           | x | 0.1            | =   | 9.53         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 44.07                | × | 0.63           | x | 0.1            | =   | 6.06         | (77) |
| Southeast 0.9 | 0.77                     | x | 3.15       | x | 31.49                | x | 0.63           | x | 0.1            | =   | 4.33         | (77) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 36.79                |   | 0.63           | x | 0.1            | =   | 14.31        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 62.67                |   | 0.63           | x | 0.1            | =   | 24.38        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 85.75                |   | 0.63           | x | 0.1            | =   | 33.36        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 106.25               |   | 0.63           | x | 0.1            | =   | 41.33        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 119.01               |   | 0.63           | x | 0.1            | =   | 46.3         | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 118.15               |   | 0.63           | x | 0.1            | =   | 45.96        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 113.91               |   | 0.63           | x | 0.1            | =   | 44.31        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 104.39               |   | 0.63           | x | 0.1            | =   | 40.61        | (79) |
| Southwest0.9  | -                        | x | 8.91       | x | 92.85                |   | 0.63           | x | 0.1            | =   | 36.12        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 69.27                |   | 0.63           | x | 0.1            | =   | 26.95        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 44.07                | ] | 0.63           | x | 0.1            | =   | 17.14        | (79) |
| Southwest0.9  | 0.77                     | x | 8.91       | x | 31.49                |   | 0.63           | x | 0.1            | =   | 12.25        | (79) |
| West 0.9      | 0.77                     | x | 7.2        | x | 19.64                | × | 0.63           | x | 0.1            | =   | 6.17         | (80) |
| West 0.9      | 0.77                     | x | 7.2        | x | 38.42                | × | 0.63           | x | 0.1            | =   | 12.08        | (80) |
| West 0.9      | 0.77                     | x | 7.2        | x | 63.27                | x | 0.63           | x | 0.1            | =   | 19.89        | (80) |

| West 0.9x   |  |  |  | ٦   |  | <b>-</b>  |  | <b>-</b>   |   | _  |       |  |
|---|--|--|--|---|--|---|--|--|---|--|-------|--|
|   | 0.77   | ×  | 7.2  |   | 92.28  |   | 0.63   | ×  | 0.1   | =  | 29.01 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  |   | 113.09   | ×   | 0.63   | _ ×  | 0.1   | =  | 35.55 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  |   | 115.77   | _ ×   | 0.63   | _ ×  | 0.1   | =  | 36.39 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ×   | 110.22   |   | 0.63   | _ ×  | 0.1   | =  | 34.65 | (80)   |
| West 0.9x   | 0.77   | X  | 7.2  | ×   | 94.68  | ×   | 0.63   | ×  | 0.1   | =  | 29.76 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ×   | 73.59  | ×   | 0.63   | ×  | 0.1   | =  | 23.13 | (80)   |
| West 0.9x   | 0.77   | ×  | 7.2  | ×   | 45.59  | ×   | 0.63   | ×  | 0.1   | =  | 14.33 | (80)   |
| West 0.9x   | 0.77   | x  | 7.2  | x   | 24.49  | x   | 0.63   | ×  | 0.1   | =  | 7.7   | (80)   |
| West 0.9x   | 0.77   | x  | 7.2  | x   | 16.15  | x   | 0.63   | x  | 0.1   | =  | 5.08  | (80)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 11.28  | x   | 0.63   | ×  | 0.1   | =  | 5.43  | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 22.97  | x   | 0.63   | x  | 0.1   | =  | 11.05 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 41.38  | x   | 0.63   | x  | 0.1   | =  | 19.92 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 67.96  | x   | 0.63   | x  | 0.1   | =  | 32.71 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 91.35  | x   | 0.63   | x  | 0.1   | =  | 43.97 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 97.38  | x   | 0.63   | x  | 0.1   | =  | 46.88 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 91.1   | x   | 0.63   | x  | 0.1   | =  | 43.85 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | x   | 72.63  | x   | 0.63   | x  | 0.1   | =  | 34.96 | (81)   |
| Northwest 0.9x  | 0.77   | x  | 11.02  | X   | 50.42  | x   | 0.63   | x  | 0.1   | =  | 24.27 | (81)   |
| Northwest 0.9x  | 0.77   | ×  | 11.02  | x   | 28.07  | 7 ×   | 0.63   | x  | 0.1   | - 1  | 13.51 | (81)   |
| Northwest 0.9x  | 0.77   | ×  | 11.02  | x   | 14.2   | ٦ 🔨   | 0.63   | x  | 0.1   | =  | 6.83  | (81)   |
|   |  |  |  |   |  |   |  |  |   |  |       |  |
| Northwest 0.9x  | 0.7 <mark>7</mark>   | ×  | 11.02  | X   | 9.21   | ×   | 0.63   | x  | 0.1   | =  | 4.44  | (81)   |
| Northwest <sub>0.9x</sub>   | 0.77   | ×  | 11.02  | x   | 9.21   | <b>X</b>  | 0.63   | ×  | 0.1   | =  | 4.44  | (81)   |
| Nort <mark>hwest<sub>0.9x</sub><br/>Solar <u>gains ir</u></mark>  |  | 7  |  | ) ×   | 9.21   | _/  | 0.63<br>n = Sum(74)m .   |  | 0.1   | =  | 4.44  | (81)   |
|   | watts, calo  | 7  |  |   | 9.21<br>50.92 143.56   | (83)m   | n = Sum(74)m .   |  |   | 26.61  | 4.44  | (81)   |
| Sola <mark>r gains ir</mark>  | watts, cald  | culated<br>87.27   | for each mo<br>121.46 147.   | 29 1  | 50.92 143.56   | (83)m   | n = Sum(74)m .   | (82)m  |   |  | 4.44  | (83)   |
| Solar gains ir<br>(83)m= 31.61  | watts, cald<br>57.41   | culated<br>87.27   | for each mo<br>121.46 147.   | 29   1<br>m + (   | 50.92 143.56   | (83)m<br>123  | 1 <del>= Sum(74)</del> m .<br>.74 99.11  | (82)m  | 38.53   |  | 4.44  |  |
| Solar gains ir<br>(83)m= 31.61<br>Total gains –   | watts, calo<br>57.41<br>internal and<br>497.94   | culated<br>87.27<br>d solar<br>512.83  | for each mo<br>121.46 147.<br>(84)m = (73)<br>523.4 525.   | 29 1<br>m + (<br>43 5   | 50.92 143.56<br>83)m , watts   | (83)m<br>123  | n <del>= Sum(74)m</del> .<br>.74 99.11   | (82)m<br>65.88   | 38.53   | 26.61  | 4.44  | (83)   |
| Solar gains ir<br>(83)m= 31.61<br>Total gains –<br>(84)m= 474.94<br>7. Mean inte  | watts, calo<br>57.41<br>internal and<br>497.94<br>trnal tempe  | culated<br>87.27<br>d solar<br>512.83<br>rature (  | for each mo<br>121.46 147.<br>(84)m = (73)<br>523.4 525.<br>(heating seas  | 29 1<br>m + (<br>43 5<br>son)   | 50.92 143.56<br>83)m , watts   | (83)m<br>3 123<br>472   | n = Sum(74)m .<br>.74 99.11<br>.02 460   | (82)m<br>65.88   | 38.53   | 26.61  | 4.44  | (83)   |
| Solar gains ir<br>(83)m= 31.61<br>Total gains –<br>(84)m= 474.94<br>7. Mean inte<br>Temperature   | watts, cald<br>57.41<br>internal and<br>497.94<br>trnal tempe<br>during hea  | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po  | for each mo<br>121.46 147.<br>(84)m = (73)<br>523.4 525.<br>(heating sease<br>eriods in the  | 29 1<br>m + (<br>43 5<br>son)<br>living   | 50.92 143.56<br>83)m , watts<br>06.59 485.08   | (83)m<br>123<br>472<br>able 9   | n = Sum(74)m .<br>.74 99.11<br>.02 460   | (82)m<br>65.88   | 38.53   | 26.61  |       | (83)   |
| Solar gains ir<br>(83)m= 31.61<br>Total gains –<br>(84)m= 474.94<br>7. Mean inte<br>Temperature   | watts, cald<br>57.41<br>internal and<br>497.94<br>trnal tempe<br>during hea  | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po  | for each mo<br>121.46 147.<br>(84)m = (73)<br>523.4 525.<br>(heating sease<br>eriods in the  | 29 1<br>m + (<br>43 5<br>son)<br>living   | 50.92 143.56<br>83)m , watts<br>06.59 485.08<br>area from Ta   | (83)m<br>(83)m<br>(123<br>(123<br>(123<br>(123))<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(1 | n = Sum(74)m .<br>.74 99.11<br>.02 460   | (82)m<br>65.88   | 38.53   | 26.61  |       | (83)   |
| Solar gains ir<br>(83)m= 31.61<br>Total gains –<br>(84)m= 474.94<br>7. Mean inte<br>Temperature<br>Utilisation fa   | watts, calo<br>57.41<br>internal and<br>497.94<br>rnal tempe<br>during hea<br>ctor for gain  | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating points for li   | for each mo<br>121.46 147.<br>(84)m = (73)<br>523.4 525.<br>(heating sease<br>eriods in the<br>iving area, h   | 29 1<br>m + (<br>43 5<br>son)<br>living<br>l,m (s<br>ay   | 50.92 143.56<br>83)m , watts<br>66.59 485.08<br>area from Ta<br>see Table 9a)  | (83)m<br>(83)m<br>(123<br>(123<br>(123<br>(123))<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(1 | r = Sum(74)m .<br>.74 99.11<br>.02 460<br>, Th1 (°C)<br>ug Sep   | (82)m<br>65.88<br>450.6  | 38.53   | 26.61  |       | (83)   |
| Solar gains ir<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean inter<br>Temperature<br>Utilisation far<br>(86)m = 1  | watts, cald<br>57.41<br>internal and<br>497.94<br>497.94<br>ctor for gain<br>Feb<br>1  | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po<br>ns for li<br>Mar<br>1   | for each mo         121.46       147.         (84)m = (73)         523.4       525.         (heating seared)         eriods in the         iving area, hr         Apr       M         0.99       0.9   | 29 1<br>m + (<br>43 5<br>son)<br>living<br>l,m (s<br>ay<br>5  | 50.92       143.56         83)m       , watts         306.59       485.08         area from Ta         see Table 9a)         Jun       Jul         0.83       0.66   | (83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(8  | 1 = Sum(74)m .         .74       99.11         .02       460         , Th1 (°C)         ug       Sep         59       0.91   | (82)m<br>65.88<br>450.6 <sup>-</sup><br>Oct  | 38.53<br>450.26<br>Nov  | 26.61<br>458.4<br>Dec                                      |       | (83)<br>(84)<br>(85)   |
| Solar gains ir<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean inter<br>Temperature<br>Utilisation far<br>(86)m = 1  | watts, calo<br>57.41<br>internal and<br>497.94<br>rnal tempe<br>e during hea<br>ctor for gain<br>Feb<br>1  | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po<br>ns for li<br>Mar<br>1   | for each mo         121.46       147.         (84)m = (73)         523.4       525.         (heating seared)         eriods in the         iving area, hr         Apr       M         0.99       0.9   | 29 1<br>m + (<br>43 5<br>son)<br>living<br>l,m (s<br>ay<br>5<br>(follo  | 50.92 143.56<br>83)m , watts<br>06.59 485.08<br>area from Ta<br>see Table 9a)<br>Jun Jul   | (83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(8  | I = Sum(74)m .         .74       99.11         .02       460         , Th1 (°C)         ug       Sep         59       0.91         Table 9c)   | (82)m<br>65.88<br>450.6 <sup>-</sup><br>Oct  | 38.53<br>450.26<br>Nov  | 26.61<br>458.4<br>Dec                                      |       | (83)<br>(84)<br>(85)   |
| Solar gains in<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean inter-<br>Utilisation factor<br>(86)m = 1<br>Mean interna<br>(87)m = 20.06  | watts, cald<br>57.41<br>internal and<br>497.94<br>trnal tempe<br>during hea<br>ctor for gain<br>Feb<br>1<br>1<br>al temperat<br>20.15  | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating pe<br>ns for li<br>Mar<br>1<br>20.31  | for each mo         121.46       147.         (84)m = (73)         523.4       525.         (heating sease         eriods in the         iving area, h         0.99       0.9         iving area Tr         20.54       20.7   | 29 1<br>m + (<br>43 5<br>son)<br>living<br>l,m (s<br>ay<br>5<br>(follo<br>77 2  | 50.92       143.56         83)m       , watts         66.59       485.08         area from Tage         area from Tage         area from Jul         0.83       0.66         ow steps 3 to         20.94       20.99   | (83)m<br>(83)m<br>123<br>472<br>472<br>able 9<br>A<br>0.6<br>7 in T<br>20.  | I = Sum(74)m .         .74       99.11         .02       460         , Th1 (°C)         ug       Sep         59       0.91         Table 9c)       98         20.88  | (82)m<br>65.88<br>450.6<br>0.99  | 38.53<br>1 450.26<br>Nov<br>1   | 26.61<br>458.4<br>Dec<br>1                                 |       | (83)<br>(84)<br>(85)<br>(86)   |
| Solar gains ir<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean inter-<br>Temperature<br>Utilisation fa<br>(86)m = 1<br>Mean interna<br>(87)m = 20.06<br>Temperature  | watts, cald<br>57.41<br>internal and<br>497.94<br>e during hea<br>ctor for gain<br>Feb<br>1<br>al temperat<br>20.15<br>e during hea  | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po<br>ns for li<br>Mar<br>1<br>20.31<br>ating po                                  | for each mo121.46147. $(84)m = (73)$ 523.4525.(heating seaseeriods in thetving area, hrAprM0.990.9iving area Tr20.5420.3eriods in rest   | 29 1<br>m + (<br>43 5<br>son)<br>living<br>l,m (s<br>ay<br>5<br>(follo<br>77 2<br>0f dv   | 50.92       143.56         83)m , watts       306.59         485.08       485.08         area from Ta       306.59         Jun       Jul         0.83       0.66         ow steps 3 to       20.99         velling from T       1000000000000000000000000000000000000  | (83)m<br>(83)m<br>(83)m<br>(123<br>(83)m<br>(123<br>(83)m<br>(123)<br>(83)m<br>(123)<br>(83)m<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123  | I = Sum(74)m .         .74       99.11         .02       460         , Th1 (°C)         ug       Sep         59       0.91         Table 9c)       98         98       20.88         9, Th2 (°C)   | (82)m<br>65.88<br>450.6<br>0ct<br>0.99<br>20.61  | 38.53<br>450.26<br>Nov<br>1<br>20.3   | 26.61<br>458.4<br>Dec<br>1<br>20.05                        |       | (83)<br>(84)<br>(85)<br>(85)<br>(86)<br>(87)                         |
| Solar gains in<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean intervent<br>Utilisation far<br>(86)m = 1<br>Mean intervent<br>(87)m = 20.06<br>Temperature<br>(88)m = 20.16  | watts, cald<br>57.41<br>internal and<br>497.94<br>e during hea<br>ctor for gain<br>Feb<br>1<br>al temperat<br>20.15<br>e during hea<br>20.16   | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po<br>ns for li<br>Mar<br>1<br>20.31<br>ating po<br>20.17                         | for each mo         121.46       147.         (84)m = (73)         523.4       525.         (heating sear         eriods in the         iving area, hr         0.99       0.9         iving area Tr         20.54       20.3         eriods in rest         20.18       20.3 | 29     1       m + (       43     5       son)       living       l,m (s       ay       5       (follo       7     2       of dv       8     2  | 50.92       143.56         83)m       , watts         306.59       485.08         area from Tage         area from Tage         area from Jul         Jun       Jul         0.83       0.66         ow steps 3 to         20.94       20.99         velling from T         20.19       20.19   | (83)m<br>(83)m<br>(83)m<br>(123<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83)m<br>(83  | I = Sum(74)m .         .74       99.11         .02       460         , Th1 (°C)         ug       Sep         59       0.91         Table 9c)       98         98       20.88         9, Th2 (°C)   | (82)m<br>65.88<br>450.6<br>0.99  | 38.53<br>450.26<br>Nov<br>1<br>20.3   | 26.61<br>458.4<br>Dec<br>1                                 |       | (83)<br>(84)<br>(85)<br>(86)   |
| Solar gains in<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean inter-<br>Utilisation fa<br>(86)m = 1<br>Mean interna<br>(87)m = 20.06<br>Temperature<br>(88)m = 20.16<br>Utilisation fa                                  | watts, cald<br>57.41<br>internal and<br>497.94 (<br>rnal tempe<br>e during hea<br>ctor for gain<br>Feb<br>1<br>al temperat<br>20.15<br>e during hea<br>20.16<br>ctor for gain                          | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po<br>ns for li<br>Mar<br>1<br>20.31<br>ating po<br>20.17<br>ns for r             | for each mo121.46147. $(84)m = (73)$ 523.4525.(heating seaseeriods in thetving area, h $Apr$ M $0.99$ $0.9$ iving area T $20.54$ $20.7$ eriods in rest $20.18$ $20.7$ est of dwellir   | 29 1<br>m + (<br>43 5<br>son)<br>living<br>l,m (s<br>ay<br>(follo<br>7 2<br>(follo<br>7 2<br>0 f dv<br>8 2<br>2<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>9<br>1<br>9<br>9<br>9<br>9<br>9<br>9 | 50.92       143.56         83)m , watts       306.59         485.08       485.08         area from Table 9a)       30         Jun Jul       30.66         ow steps 3 to       20.94         20.94       20.99         velling from T       20.19         ,m (see Table       30  | (83)m<br>(83)m<br>123<br>472<br>472<br>472<br>A<br>0.6<br>7 in T<br>20.<br>-<br>able 9<br>20.<br>-<br>able 9<br>20.<br>e 9a)  | I = Sum(74)m .         .74       99.11         .02       460         , Th1 (°C)         ug       Sep         59       0.91         Table 9c)       98         98       20.88         9, Th2 (°C)       19         19       20.18   | (82)m<br>65.88<br>450.6 <sup>°</sup><br>0.99<br>20.61<br>20.18   | 38.53<br>450.26<br>Nov<br>1<br>20.3<br>20.17                                    | 26.61<br>458.4<br>Dec<br>1<br>20.05<br>20.17               |       | (83)<br>(84)<br>(85)<br>(86)<br>(86)<br>(87)<br>(88)                 |
| Solar gains in<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean inter-<br>Temperature<br>Utilisation fa<br>(86)m = 1<br>Mean interna<br>(87)m = 20.06<br>Temperature<br>(88)m = 20.16<br>Utilisation fa<br>(89)m = 1      | watts, cald<br>57.41<br>internal and<br>497.94 (<br>rnal tempe<br>e during hea<br>ctor for gain<br>Feb<br>1<br>al temperat<br>20.15<br>e during hea<br>20.16<br>ctor for gain<br>1                     | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating points for line<br>Mar<br>1<br>20.31<br>ating points<br>20.17<br>ns for r<br>0.99 | for each mo121.46147. $(84)m = (73)$ 523.4525.(heating seaseeriods in thetving area, hAprM0.990.9iving area T20.5420.7eriods in rest20.1820.7est of dwellir0.980.9   | 29     1       m + (       43     5       son)       living        ,m (s       ay       5       (folle       7     2       of dv       8     2       ag, h2       3                                       | 50.92       143.56         83)m       , watts         506.59       485.08         area from Table 9a)         Jun       Jul         0.83       0.66         ow steps 3 to         20.94       20.99         velling from T         20.19       20.19         ,m (see Table         0.76       0.54   | (83)m<br>(83)m<br>123<br>472<br>472<br>472<br>A<br>0.6<br>7 in T<br>20.<br>7 able 9<br>20.<br>20.<br>e 9a)<br>0.5   | I = Sum(74)m .         .74       99.11         .02       460         .02       460         , Th1 (°C)  | (82)m<br>65.88<br>450.6 <sup>2</sup><br>450.6 <sup>2</sup><br>0.99<br>20.61<br>20.18                           | 38.53<br>450.26<br>Nov<br>1<br>20.3   | 26.61<br>458.4<br>Dec<br>1<br>20.05                        |       | (83)<br>(84)<br>(85)<br>(85)<br>(86)<br>(87)                         |
| Solar gains in<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean internet<br>Utilisation fa<br>(86)m = 1<br>Mean internet<br>(87)m = 20.06<br>Temperature<br>(88)m = 20.16<br>Utilisation fa<br>(89)m = 1<br>Mean internet | watts, calo<br>57.41<br>internal and<br>497.94 &<br>rnal tempe<br>e during hea<br>ctor for gain<br>Feb<br>1<br>1<br>al temperat<br>20.15<br>e during hea<br>20.16<br>ctor for gain<br>1<br>al temperat | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating po<br>ating po<br>1<br>20.31<br>ating po<br>20.17<br>ns for r<br>0.99             | for each mo121.46147. $(84)m = (73)$ $523.4$ $525.$ (heating seareriods in theving area, hr $Apr$ M $0.99$ $0.9$ iving area Tr $20.54$ $20.7$ eriods in rest $20.54$ $20.7$ eriods in rest $20.18$ $20.7$ est of dwellir $0.98$ $0.9$  | 29     1       m + (       43     5       son)       living       l,m (s       ay       5       (follo       7     2       of dv       8     2       ag, h2       3       velling                         | 50.92       143.56         83)m       , watts         306.59       485.08         area from Tage         0.83       0.66         ow steps 3 to         20.94       20.99         velling from T         20.19       20.19         ,m (see Table         0.76       0.54         T2 (follow st | (83)m<br>(83)m<br>(83)m<br>(123<br>(83)m<br>(123<br>(83)m<br>(123<br>(83)m<br>(123<br>(83)m<br>(123<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(1  | I = Sum(74)m .         .74       99.11         .02       460         , Th1 (°C)         ug       Sep         39       0.91         Table 9c)       98         98       20.88         9, Th2 (°C)       19         19       20.18         59       0.86         59       0.86                   | (82)m<br>65.88<br>450.6<br>450.6<br>0.99<br>20.61<br>20.18<br>0.98<br>e 9c)                                    | 38.53         450.26         Nov         1         20.3         20.17         1 | 26.61<br>458.4<br>Dec<br>1<br>20.05<br>20.17               |       | (83)<br>(84)<br>(85)<br>(85)<br>(86)<br>(87)<br>(88)<br>(88)<br>(89) |
| Solar gains in<br>(83)m = 31.61<br>Total gains –<br>(84)m = 474.94<br>7. Mean inter-<br>Temperature<br>Utilisation fa<br>(86)m = 1<br>Mean interna<br>(87)m = 20.06<br>Temperature<br>(88)m = 20.16<br>Utilisation fa<br>(89)m = 1      | watts, calo<br>57.41<br>internal and<br>497.94 &<br>rnal tempe<br>e during hea<br>ctor for gain<br>Feb<br>1<br>1<br>al temperat<br>20.15<br>e during hea<br>20.16<br>ctor for gain<br>1<br>al temperat | culated<br>87.27<br>d solar<br>512.83<br>rature (<br>ating points for line<br>Mar<br>1<br>20.31<br>ating points<br>20.17<br>ns for r<br>0.99 | for each mo121.46147. $(84)m = (73)$ 523.4525.(heating seaseeriods in thetving area, hAprM0.990.9iving area T20.5420.7eriods in rest20.1820.7est of dwellir0.980.9   | 29     1       m + (       43     5       son)       living       l,m (s       ay       5       (follo       7     2       of dv       8     2       ag, h2       3       velling                         | 50.92       143.56         83)m       , watts         506.59       485.08         area from Table 9a)         Jun       Jul         0.83       0.66         ow steps 3 to         20.94       20.99         velling from T         20.19       20.19         ,m (see Table         0.76       0.54   | (83)m<br>(83)m<br>(83)m<br>(123<br>(83)m<br>(123<br>(83)m<br>(123<br>(83)m<br>(123<br>(83)m<br>(123<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(123)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(12)<br>(1  | I = Sum(74)m .         .74       99.11         .02       460         .02       460         , Th1 (°C)       98         .09       0.91         Table 9c)       98         .03       20.88         .04       20.18         .05       0.86         .06       10 7 in Table         18       20.08 | (82)m<br>65.88<br>450.6 <sup>°</sup><br>450.6 <sup>°</sup><br>20.61<br>20.18<br>20.18<br>0.98<br>e 9c)<br>19.7 | 38.53<br>450.26<br>Nov<br>1<br>20.3<br>20.17                                    | 26.61<br>458.4<br>Dec<br>1<br>20.05<br>20.17<br>1<br>18.88 |       | (83)<br>(84)<br>(85)<br>(86)<br>(86)<br>(87)<br>(88)                 |

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$ 

| _            |           |           | -                      |                      |                     |             |           |                        |            |              |                 |            | _         |        |
|--------------|-----------|-----------|------------------------|----------------------|---------------------|-------------|-----------|------------------------|------------|--------------|-----------------|------------|-----------|--------|
| (92)m=       | 19.25     | 19.36     | 19.58                  | 19.88                | 20.18               | 20.38       | 20.43     | 20.42                  | 20.32      | 19.98        | 19.57           | 19.24      |           | (92)   |
| · · · · r    | -         |           | 1                      |                      |                     |             |           | e 4e, whe              | · · ·      | opriate      |                 |            | I         |        |
| (93)m=       | 19.25     | 19.36     | 19.58                  | 19.88                | 20.18               | 20.38       | 20.43     | 20.42                  | 20.32      | 19.98        | 19.57           | 19.24      |           | (93)   |
|              |           |           | uirement               |                      |                     |             |           |                        |            |              |                 |            |           |        |
|              |           |           |                        | nperatur<br>using Ta |                     | ed at ste   | ep 11 of  | Table 9t               | o, so tha  | t Ti,m=(     | 76)m an         | d re-calc  | culate    |        |
|              | Jan       | Feb       | Mar                    | Apr                  | May                 | Jun         | Jul       | Aug                    | Sep        | Oct          | Nov             | Dec        |           |        |
| L<br>Utilisa |           |           | ains, hm               |                      |                     |             |           | - 5                    |            |              |                 |            |           |        |
| (94)m=       | 1         | 1         | 0.99                   | 0.98                 | 0.93                | 0.78        | 0.58      | 0.62                   | 0.87       | 0.98         | 0.99            | 1          |           | (94)   |
| Usefu        | l gains,  | hmGm ,    | , W = (94              | 4)m x (84            | 4)m                 |             |           |                        |            |              |                 |            |           |        |
| (95)m=       | 473.67    | 495.88    | 508.61                 | 511.8                | 488.6               | 396.61      | 280.39    | 292.24                 | 398.71     | 440.14       | 447.82          | 457.41     |           | (95)   |
| Month        | ly avera  | age exte  | rnal tem               | perature             | from Ta             | able 8      |           | i                      |            |              |                 |            |           |        |
| (96)m=       | 4.3       | 4.9       | 6.5                    | 8.9                  | 11.7                | 14.6        | 16.6      | 16.4                   | 14.1       | 10.6         | 7.1             | 4.2        |           | (96)   |
| г            |           |           | i                      | · · ·                |                     |             | - /       | x [(93)m·              | , <i>,</i> | -            |                 |            | I         |        |
|              |           | 1106.35   |                        | 828.7                | 638.15              | 430.01      | 284.63    | 298.65                 | 465.16     | 705.61       | 942.96          | 1142.3     |           | (97)   |
| · r          |           |           |                        |                      | 10nth, k\<br>111.27 |             |           | 24 x [(97)             |            |              | r –             | 500 55     | l         |        |
| (98)m=       | 500.55    | 410.24    | 364.08                 | 228.17               | 111.27              | 0           | 0         | 0                      | 0          | 197.51       | 356.51          | 509.55     | 0077.00   |        |
|              |           |           |                        |                      | ,                   |             |           | lota                   | i per year | (kvvn/year   | ) = Sum(9       | 8)15,912 = | 2677.88   | (98)   |
| Space        | heating   | g require | ement in               | kWh/m <sup>2</sup>   | /year               |             |           |                        |            |              |                 |            | 31.62     | (99)   |
| 9b. Ene      | ergy req  | uiremer   | nts – Cor              | nmunity              | heating             | scheme      |           |                        |            |              |                 |            |           |        |
|              |           |           |                        |                      |                     |             |           | ting prov<br>(Table 11 |            |              | unity sch       | neme.      | 0         | (301)  |
|              |           |           |                        |                      |                     |             |           |                        | 1) 0 11 11 | one          |                 |            | 0         |        |
| Fractio      | n of spa  | ice heat  | from co                | mmunity              | system              | 1 – (301    | I) =      |                        |            |              |                 |            | 1         | (302)  |
|              |           |           |                        |                      |                     |             |           | allows for             |            | ıp to four ( | other heat      | sources; t | he latter |        |
|              |           |           | -                      | ity heat p           |                     | om power    | stations. | See Apper              | iuix C.    |              |                 |            | 1         | (303a) |
|              |           |           |                        | m Comm               | -                   | eat pump    | )         |                        |            | (3           | -<br>02) x (303 | a) =       | 1         | (304a) |
| Factor       | for cont  | rol and o | charging               | method               | (Table 4            | 4c(3)) fo   | r commu   | unity hea              | iting syst | tem          |                 |            | 1         | (305)  |
| Distribu     | ition los | s factor  | (Table 1               | 2c) for c            | ommun               | ity heatir  | ng syste  | m                      |            |              |                 |            | 1         | (306)  |
| Space        | heating   | 3         |                        |                      |                     |             |           |                        |            |              |                 |            | kWh/year  |        |
| Annual       | space     | heating   | requirem               | nent                 |                     |             |           |                        |            |              |                 |            | 2677.88   |        |
| Space        | heat fro  | m Comr    | munity h               | eat pum              | þ                   |             |           |                        | (98) x (30 | 04a) x (30   | 5) x (306) =    | =          | 2677.88   | (307a) |
| Efficien     | cy of se  | econdary  | y/supple               | mentary              | heating             | system      | in % (frc | om Table               | 4a or A    | ppendix      | E)              |            | 0         | (308   |
| Space        | heating   | require   | ment fro               | m secon              | dary/sup            | plemen      | tary syst | tem                    | (98) x (30 | )1) x 100 -  | ÷ (308) =       |            | 0         | (309)  |
| Water        |           |           |                        | - mt                 |                     |             |           |                        |            |              |                 |            |           | 7      |
|              |           |           | equirem                |                      |                     |             |           |                        |            |              |                 |            | 2117.69   |        |
|              |           |           | ty scherr<br>nunity he | eat pump             | )                   |             |           |                        | (64) x (30 | )3a) x (30   | 5) x (306) =    | =          | 2117.69   | (310a) |
| Electric     | ity used  | l for hea | at distribu            | ution                |                     |             |           | 0.01                   | × [(307a). | (307e) +     | · (310a)(       | 310e)] =   | 47.96     | (313)  |
| Cooling      | g Syster  | n Energ   | y Efficie              | ncy Ratio            | C                   |             |           |                        |            |              |                 |            | 0         | (314)  |
| Space        | cooling   | (if there | is a fixe              | d cooling            | g system            | n, if not e | enter 0)  |                        | = (107) ÷  | (314) =      |                 |            | 0         | (315)  |

| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside                           | Г          | 191.68                 | (330a) |
|--|------------|------------------------|--------|
| warm air heating system fans   | Ē          | 0                      | (330b) |
| pump for solar water heating   |            | 0                      | (330g) |
| Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =  |            | 191.68                 | (331)  |
| Energy for lighting (calculated in Appendix L)   |            | 472.85                 | (332)  |
| Electricity generated by PVs (Appendix M) (negative quantity)  |            | -664.99                | (333)  |
| Electricity generated by wind turbine (Appendix M) (negative quantity)   |            | 0                      | (334)  |
| 12b. CO2 Emissions – Community heating scheme  |            |                        |        |
| Energy Emission<br>kWh/year kg CO2/k   |            | missions<br>g CO2/year |        |
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the s | econd fuel | 364                    | (367a) |
| CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x 0.52  | =          | 683.76                 | (367)  |
| Electrical energy for heat distribution [(313) x 0.52  | =          | 24.89                  | (372)  |
| Total CO2 associated with community systems (363)(366) + (368)(372)  | =          | 708.65                 | (373)  |
| CO2 associated with space heating (secondary) (309) × 0  | =          | 0                      | (374)  |
| CO2 associated with water from immersion heater or instantaneous heater (312) x 0.52   | =          | 0                      | (375)  |
| Total CO2 associated with space and water heating (373) + (374) + (375) =  |            | 708.65                 | (376)  |
| CO2 associated with electricity for pumps and fans within dwelling (331)) x 0.52   | =          | 99.48                  | (378)  |
| CO2 associated with electricity for lighting (332))) x 0.52  | =          | 245.41                 | (379)  |
| Energy saving/generation technologies (333) to (334) as applicable Item 1 0.52   | x 0.01 =   | -345.13                | (380)  |
| Total CO2, kg/year sum of (376)(382) =   |            | 708.42                 | (383)  |
| Dwelling CO2 Emission Rate (383) ÷ (4) =   | Ē          | 8.36                   | (384)  |
| El rating (section 14)   | Ľ          | 92.68                  | (385)  |

|   |                             | L                 | Jser De     | etails:                      |                |                 |                       |           |                                       |              |
|---|-----------------------------|-------------------|-------------|------------------------------|----------------|-----------------|-----------------------|-----------|---------------------------------------|--------------|
| Assessor Name:<br>Software Name:  | Stroma FSAP 2012            |                   | ę           | Stroma<br>Softwa<br>.ddress: | re Ver         |                 |                       | Versio    | n: 1.0.4.23                           |              |
| Addross   | 3 Bed Flat, 219-223         |                   |             |                              |                | nh lunct        | ion I ON              |           |                                       |              |
| Address :<br>1. Overall dwelling dimen  |                             | Columation        |             | ie, Loug                     | προιοαί        | JII JUIICI      | ION, LON              |           |                                       |              |
| Ground floor  |                             |                   | <b>Area</b> | · ·                          | (1a) x         | <b>Av. He</b> i | <b>ight(m)</b><br>2.5 | (2a) =    | <b>Volume(m<sup>3</sup>)</b><br>124.5 | (3a)         |
| Total floor area TFA = (1a)   | )+(1b)+(1c)+(1d)+(1e)       | +(1n)             | 49          | 9.8                          | (4)            |                 |                       |           |                                       |              |
| Dwelling volume   | 124.5                       | (5)               |             |                              |                |                 |                       |           |                                       |              |
| 2. Ventilation rate:  |                             |                   |             |                              |                |                 |                       |           |                                       |              |
| Number of chimpove  | heating he                  | condary<br>eating | c<br>+ [    | other                        | ] = [          | total           | v/                    | 40 =      | m <sup>3</sup> per hour               | _            |
| Number of chimneys<br>Number of open flues  |                             | 0                 | +           | 0                            | ] - [<br>] = [ | 0               |                       | 20 =      | 0                                     | (6a)<br>(6b) |
| Number of intermittent fan  | s                           |                   |             | -                            |                | 0               | x ^                   | 10 =      | 0                                     | (7a)         |
| Number of passive vents   |                             |                   |             |                              | Ē              | 0               | x ′                   | 10 =      | 0                                     | (7b)         |
| Number of flueless gas fire   | es                          |                   |             |                              |                | 0               | X 4                   | 40 =      | 0                                     | (7c)         |
|   |                             |                   |             |                              |                |                 |                       | Air ch    | anges per ho                          | ur           |
| Infiltration due to chimney   |                             |                   |             |                              |                | 0               |                       | ÷ (5) =   | 0                                     | (8)          |
| If a pressurisation test has be<br>Number of storeys in the<br>Additional infiltration      |                             | a, proceed to     | o (17), ot  | nerwise c                    | ontinue ind    | om (9) to (     |                       | -1]x0.1 = | 0                                     | (9)<br>(10)  |
| Structural infiltration: 0.2<br>if both types of wall are pre<br>deducting areas of opening | sent, use the value corresp |                   |             |                              |                | uction          | -                     |           | 0                                     | (11)         |
| If suspended wooden flo   |                             | ed) or 0.1        | (sealed     | d), else (                   | enter 0        |                 |                       |           | 0                                     | (12)         |
| If no draught lobby, ente   | r 0.05, else enter 0        |                   |             |                              |                |                 |                       |           | 0                                     | (13)         |
| Percentage of windows   | and doors draught str       | ipped             |             |                              |                |                 |                       |           | 0                                     | (14)         |
| Window infiltration   |                             |                   |             | ).25 - [0.2                  |                |                 |                       |           | 0                                     | (15)         |
| Infiltration rate   |                             |                   |             |                              |                | 2) + (13) -     |                       |           | 0                                     | (16)         |
| Air permeability value, q   |                             | •                 | •           | •                            | •              | etre of e       | nvelope               | area      | 2                                     | (17)         |
| If based on air permeabilit<br>Air permeability value applies                               | •                           |                   |             |                              |                | is heina u      | sed                   |           | 0.1                                   | (18)         |
| Number of sides sheltered   |                             |                   | or a aogr   |                              | noability i    | o boing a       | 500                   |           | 3                                     | (19)         |
| Shelter factor  |                             |                   | (2          | 20) = 1 - [                  | 0.075 x (1     | 9)] =           |                       |           | 0.78                                  | (20)         |
| Infiltration rate incorporatir  | ng shelter factor           |                   | (2          | 21) = (18)                   | x (20) =       |                 |                       |           | 0.08                                  | (21)         |
| Infiltration rate modified fo   | r monthly wind speed        |                   |             |                              |                |                 |                       |           |                                       | _            |
| Jan Feb M   | Mar Apr May                 | Jun               | Jul         | Aug                          | Sep            | Oct             | Nov                   | Dec       |                                       |              |
| Monthly average wind spe  | ed from Table 7             |                   |             |                              |                |                 |                       |           |                                       |              |
| (22)m= 5.1 5 4  | 4.4 4.3                     | 3.8               | 3.8         | 3.7                          | 4              | 4.3             | 4.5                   | 4.7       |                                       |              |
| Wind Factor (22a)m = (22)   | )m ÷ 4                      |                   |             |                              |                |                 |                       |           |                                       |              |
| (22a)m= 1.27 1.25 1.  | .23 1.1 1.08                | 0.95              | 0.95        | 0.92                         | 1              | 1.08            | 1.12                  | 1.18      |                                       |              |

| Adjuste                          | ed infiltra           | ation rat  | e (allowi  | ng for sh               | elter an    | d wind s    | peed) =    | (21a) x      | (22a)m      |                       | _                |           |                  |                |
|----------------------------------|-----------------------|------------|------------|-------------------------|-------------|-------------|------------|--------------|-------------|-----------------------|------------------|-----------|------------------|----------------|
|                                  | 0.1                   | 0.1        | 0.09       | 0.09                    | 0.08        | 0.07        | 0.07       | 0.07         | 0.08        | 0.08                  | 0.09             | 0.09      |                  |                |
|                                  | ate effec<br>echanica |            | -          | rate for t              | he appli    | cable ca    | se         |              |             |                       |                  |           | 0.5              | (220)          |
|                                  |                       |            |            | endix N, (2             | 3b) = (23a  | a) x Fmv (e | equation ( | N5)) . other | wise (23b   | ) = (23a)             |                  |           | 0.5              | (23a)<br>(23b) |
|                                  |                       |            |            | iency in %              |             |             |            |              |             | ) (200)               |                  |           | 0.5              |                |
|                                  |                       |            | -          | -                       | -           |             |            |              |             | 2b)m i (              | 22h) v [         | 1 – (23c) | 73.1             | (23c)          |
| (24a)m=                          |                       | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21 (24a    | 0.21        | 0.22                  | 230) × [<br>0.22 | 0.23      | - 100j           | (24a)          |
|                                  |                       |            |            |                         |             |             |            |              |             |                       |                  | 0.20      | l                | (,)            |
| D) II<br>(24b)m=                 |                       |            |            | entilation              |             |             |            | 0 (240       | 0 m = (22)  | $\frac{2}{0}$ m + (1) | 230)             | 0         | 1                | (24b)          |
|                                  |                       | -          |            | •                       | -           | -           | -          | -            | •           | 0                     | 0                | 0         |                  | (240)          |
| ,                                |                       |            |            | ntilation c<br>hen (24c | •           | •           |            |              |             | .5 × (23t             | <b>)</b> )       |           |                  |                |
| (24c)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0                     | 0                | 0         |                  | (24c)          |
|                                  |                       |            |            | ole hous                |             |             |            |              |             |                       |                  |           | 1                |                |
| i                                | if (22b)m             | n = 1, the | en (24d)   | m = (22k                | o)m othe    | erwise (2   | 4d)m =     | 0.5 + [(2    | 2b)m² x     | 0.5]                  |                  |           | 1                |                |
| (24d)m=                          | 0                     | 0          | 0          | 0                       | 0           | 0           | 0          | 0            | 0           | 0                     | 0                | 0         |                  | (24d)          |
| Effe                             | ctive air             | change     | rate - er  | nter (24a               | ) or (24b   | o) or (24   | c) or (24  | d) in box    | (25)        |                       |                  |           |                  |                |
| (25)m=                           | 0.23                  | 0.23       | 0.23       | 0.22                    | 0.22        | 0.21        | 0.21       | 0.21         | 0.21        | 0.22                  | 0.22             | 0.23      |                  | (25)           |
| 3. He                            | at losses             | s and he   | eat loss i | oaramete                | er:         |             |            |              |             |                       |                  |           |                  | _              |
| ELEN                             |                       | Gros       |            | Openin                  |             | Net Ar      | ea         | U-valu       | Je          | AXU                   |                  | k-value   | e                | AXk            |
|                                  |                       | area       |            | 'n                      |             | A ,n        | n²         | W/m2         | K           | (VV/                  | K)               | kJ/m²·l   | ĸ                | kJ/K           |
| Windo                            | ws Type               | 1          |            |                         |             | 10.8        | x1/        | [1/( 0.73 )+ | - 0.04] =   | 7.66                  |                  |           |                  | (27)           |
| Windo                            | <mark>ws</mark> Type  | 2          |            |                         |             | 2.475       | ; x1/      | [1/( 0.73 )+ | - 0.04] =   | 1.76                  |                  |           |                  | (27)           |
| Wall <mark>s</mark> <sup>-</sup> | Type1                 | 19.        | 5          | 10.8                    |             | 8.7         | x          | 0.15         | ] = [       | 1.31                  |                  |           |                  | (29)           |
| Walls <sup>-</sup>               | Гуре2                 | 3.5        |            | 2.47                    |             | 1.03        | ×          | 0.15         | <br>  =     | 0.15                  | F i              |           | <b>i i</b>       | (29)           |
| Total a                          | rea of el             | lements    | , m²       |                         |             | 23          |            |              |             |                       |                  |           |                  | (31)           |
| Party v                          | vall                  |            |            |                         |             | 51.75       | j x        | 0            |             | 0                     |                  |           |                  | (32)           |
| Party f                          | _                     |            |            |                         |             | 49.8        | $\exists$  |              | เ           |                       | L                |           | $\dashv$         | (32a)          |
| Party c                          | eiling                |            |            |                         |             | 49.8        |            |              |             |                       | ĺ                |           | $\exists$        | (32b)          |
| Interna                          | al wall **            |            |            |                         |             | 45.6        |            |              |             |                       | Ī                |           | $\exists \vdash$ | (32c)          |
|                                  |                       |            |            |                         |             |             | ated using | ı formula 1, | /[(1/U-valu | ıe)+0.04] a           | as given in      | paragraph | 3.2              |                |
|                                  | heat los              |            |            | nternal wall            | s and pan   | litions     |            | (26)(30)     | + (32) =    |                       |                  |           | 40.07            | (22)           |
|                                  | apacity (             |            |            | 0)                      |             |             |            | (20)(00)     |             | (30) + (32            | 2) + (225)       | (220) -   | 10.87            |                |
|                                  |                       |            | . ,        | - Cm ·                  |             | k l/m2k     |            |              |             | tive Value            | · · · ·          | (326) =   | 13269.5          |                |
|                                  |                       | -          |            | P = Cm ÷                | ,           |             |            | racisaly the |             |                       |                  | abla 1f   | 250              | (35)           |
|                                  | used instea           |            |            |                         | constructi  | ion ale not | KIIOWII PI | ecisely life | inucative   | values of             |                  |           |                  |                |
| Therm                            | al bridge             | es : S (L  | x Y) cal   | culated u               | using Ap    | pendix ł    | <          |              |             |                       |                  |           | 5.22             | (36)           |
|                                  |                       |            | are not kn | own (36) =              | = 0.05 x (3 | 1)          |            |              |             |                       |                  |           |                  |                |
| Total fa                         | abric hea             | at loss    |            |                         |             |             |            |              | (33) +      | (36) =                |                  |           | 16.09            | (37)           |
| Ventila                          | tion hea              | t loss ca  | alculated  | monthly                 | /           |             |            |              | (38)m       | = 0.33 × (            | 25)m x (5        | )         | 1                |                |
|                                  | Jan                   | Feb        | Mar        | Apr                     | May         | Jun         | Jul        | Aug          | Sep         | Oct                   | Nov              | Dec       |                  |                |
| (38)m=                           | 9.59                  | 9.51       | 9.43       | 9.03                    | 8.95        | 8.55        | 8.55       | 8.47         | 8.71        | 8.95                  | 9.11             | 9.27      |                  | (38)           |
| Heat tr                          | ansfer c              | oefficier  | nt, W/K    |                         |             |             |            |              | (39)m       | = (37) + (            | 38)m             |           |                  |                |
| (39)m=                           | 25.68                 | 25.6       | 25.52      | 25.12                   | 25.04       | 24.64       | 24.64      | 24.56        | 24.8        | 25.04                 | 25.2             | 25.36     |                  |                |
| Stroma I                         | FSAP 2012             | 2 Version: | 1.0.4.23   | (SAP 9.92)              | - http://ww | ww.stroma   | .com       |              | 1           | Average =             | Sum(39)1         | 12 /12=   | 25.1p            | age 2 of 39)   |

| Heat lo     | ss para    | meter (H     | HLP), W              | /m²K         |                |             |             |                        | (40)m        | = (39)m ÷   | · (4)                                 |          |         |          |
|-------------|------------|--------------|----------------------|--------------|----------------|-------------|-------------|------------------------|--------------|-------------|---------------------------------------|----------|---------|----------|
| (40)m=      | 0.52       | 0.51         | 0.51                 | 0.5          | 0.5            | 0.49        | 0.49        | 0.49                   | 0.5          | 0.5         | 0.51                                  | 0.51     |         |          |
| L           | r of dou   |              | nth (Tab             |              |                |             |             |                        | /            | Average =   | Sum(40) <sub>1</sub> .                | 12 /12=  | 0.5     | (40)     |
|             | Jan        | Feb          | Mar                  | Apr          | May            | Jun         | Jul         | Aug                    | Sep          | Oct         | Nov                                   | Dec      |         |          |
| (41)m=      | 31         | 28           | 31                   | 30           | 31             | 30          | 31          | 31                     | 30           | 31          | 30                                    | 31       |         | (41)     |
|             |            |              |                      |              |                |             | -           |                        |              |             |                                       |          |         |          |
| 4. Wat      | ter heat   | ing enei     | rgy requ             | irement:     |                |             |             |                        |              |             |                                       | kWh/ye   | ear:    |          |
| if TFA      |            |              |                      | [1 - exp     | (-0.0003       | 849 x (TF   | -A -13.9    | )2)] + 0.(             | 0013 x (1    | TFA -13     |                                       | 68       |         | (42)     |
| Reduce t    | he annua   | al average   |                      | usage by     | 5% if the a    | lwelling is | designed    | (25 x N)<br>to achieve |              | se target o |                                       | 4.2      |         | (43)     |
|             | Jan        | Feb          | Mar                  | Apr          | May            | Jun         | Jul         | Aug                    | Sep          | Oct         | Nov                                   | Dec      |         |          |
| Hot wate    | r usage ii | n litres per | r day for ea         | ach month    | Vd,m = fa      | ctor from   | Table 1c x  | (43)                   |              |             |                                       |          | I       |          |
| (44)m=      | 81.62      | 78.65        | 75.68                | 72.72        | 69.75          | 66.78       | 66.78       | 69.75                  | 72.72        | 75.68       | 78.65                                 | 81.62    |         | <b>-</b> |
| Energy c    | ontent of  | hot water    | used - cal           | culated mo   | onthly $= 4$ . | 190 x Vd,r  | m x nm x D  | OTm / 3600             |              |             | m(44) <sub>112</sub> =<br>ables 1b, 1 |          | 890.4   | (44)     |
| (45)m=      | 121.04     | 105.86       | 109.24               | 95.24        | 91.38          | 78.86       | 73.07       | 83.85                  | 84.85        | 98.89       | 107.94                                | 117.22   |         | _        |
| lf instanta | aneous w   | ater heatii  | ng at point          | t of use (no | o hot water    | storage),   | enter 0 in  | boxes (46              |              | Total = Su  | m(45) <sub>112</sub> =                | -        | 1167.46 | (45)     |
| (46)m=      | 18.16      | 15.88        | 16.39                | 14.29        | 13.71          | 11.83       | 10.96       | 12.58                  | 12.73        | 14.83       | 16.19                                 | 17.58    |         | (46)     |
| Water s     | -          |              | includir             | na anv so    | olar or M      | /WHRS       | storage     | within sa              | ame ves      | sel         |                                       | 180      |         | (47)     |
| -           |            |              | and no ta            | -            |                |             |             |                        |              |             |                                       | 100      |         | ()       |
|             | -          | -            |                      |              | -              |             |             | ombi boil              | ers) ente    | er '0' in ( | 47)                                   |          |         |          |
| Water s     | -          |              |                      |              |                |             |             |                        |              |             |                                       |          | L       |          |
|             |            |              | eclared I            |              | or is kno      | wn (kWł     | n/day):     |                        |              |             | 1.                                    | 85       |         | (48)     |
| •           |            |              | m Table              |              |                |             |             |                        |              |             | 0                                     | .6       |         | (49)     |
| •••         |            |              | storage              | -            |                |             |             | (48) x (49)            | ) =          |             | 1.                                    | 11       |         | (50)     |
| ,           |            |              | eclared of factor fr | •            |                |             |             |                        |              |             |                                       | 0        |         | (51)     |
|             |            | -            | ee secti             |              | - (            |             | <i></i>     |                        |              |             |                                       | 0        |         |          |
| Volume      | factor     | from Ta      | ble 2a               |              |                |             |             |                        |              |             |                                       | 0        |         | (52)     |
| Temper      | rature fa  | actor fro    | m Table              | 2b           |                |             |             |                        |              |             |                                       | 0        |         | (53)     |
| •••         |            |              | <sup>-</sup> storage | e, kWh/y€    | ear            |             |             | (47) x (51)            | ) x (52) x ( | 53) =       |                                       | 0        |         | (54)     |
|             |            | 54) in (5    |                      |              |                |             |             |                        |              |             | 1.                                    | 11       |         | (55)     |
| Water s     | storage    | loss cal     | culated              | for each     | month          |             |             | ((56)m = (             | 55) × (41)r  | m           |                                       |          |         |          |
| (56)m=      | 34.41      | 31.08        | 34.41                | 33.3         | 34.41          | 33.3        | 34.41       | 34.41                  | 33.3         | 34.41       | 33.3                                  | 34.41    |         | (56)     |
| If cylinde  | r contains | dedicate     | d solar sto          | rage, (57)   | m = (56)m      | x [(50) – ( | H11)] ÷ (5  | 0), else (5            | 7)m = (56)   | m where (   | H11) is fro                           | m Append | ix H    |          |
| (57)m=      | 34.41      | 31.08        | 34.41                | 33.3         | 34.41          | 33.3        | 34.41       | 34.41                  | 33.3         | 34.41       | 33.3                                  | 34.41    |         | (57)     |
| Primary     | / circuit  | loss (ar     | nnual) fro           | om Table     | e 3            |             |             |                        |              |             |                                       | 0        |         | (58)     |
|             |            |              |                      |              | ,              | ,           | • •         | 65 × (41)              |              |             |                                       |          |         |          |
|             |            |              | r                    | i            | 1              | 1           | · · · · · · | ng and a               | · ·          | i           | ,<br>                                 | -        | I       |          |
| (59)m=      | 23.26      | 21.01        | 23.26                | 22.51        | 23.26          | 22.51       | 23.26       | 23.26                  | 22.51        | 23.26       | 22.51                                 | 23.26    |         | (59)     |

| Combi    | loss ca               | alculated     | for eac   | h month      | (61)m =        | (60) ÷  | 365 × (41        | )m             |               |                     |              |             |               |      |
|----------|-----------------------|---------------|-----------|--------------|----------------|---------|------------------|----------------|---------------|---------------------|--------------|-------------|---------------|------|
| (61)m=   | 0                     | 0             | 0         | 0            | 0              | 0       | 0                | 0              | 0             | 0                   | 0            | 0           |               | (61) |
| Total h  | eat req               | uired for     | water h   | neating c    | alculated      | for e   | ach month        | (62)m =        | = 0.85 × (    | (45)m +             | (46)m +      | (57)m +     | (59)m + (61)m |      |
| (62)m=   | 178.71                | 157.95        | 166.91    | 151.05       | 149.06         | 134.6   | 7 130.75         | 141.52         | 140.67        | 156.56              | 163.76       | 174.89      | ]             | (62) |
| Solar DH | -IW input             | calculated    | using Ap  | pendix G o   | r Appendix     | H (neg  | ative quantity   | y) (enter '(   | )' if no sola | r contribut         | tion to wate | er heating) | -             |      |
| (add a   | dditiona              | al lines if   | FGHRS     | S and/or     | WWHRS          | appli   | es, see Ap       | pendix         | G)            |                     |              |             | _             |      |
| (63)m=   | 0                     | 0             | 0         | 0            | 0              | 0       | 0                | 0              | 0             | 0                   | 0            | 0           |               | (63) |
| Output   | from w                | ater hea      | ter       |              |                |         |                  |                |               |                     |              |             |               |      |
| (64)m=   | 178.71                | 157.95        | 166.91    | 151.05       | 149.06         | 134.6   | 7 130.75         | 141.52         | 140.67        | 156.56              | 163.76       | 174.89      |               | _    |
|          |                       |               | -         |              |                |         |                  | Out            | put from w    | ater heate          | r (annual)₁  | 12          | 1846.5        | (64) |
| Heat g   | ains fro              | m water       | heating   | , kWh/m      | onth 0.2       | 5 ´ [0. | 35 × (45)m       | ı + (61)r      | n] + 0.8 >    | x [(46)m            | + (57)m      | + (59)m     | ]             |      |
| (65)m=   | 86.38                 | 76.87         | 82.46     | 76.32        | 76.52          | 70.8    | 7 70.43          | 74.02          | 72.86         | 79.02               | 80.54        | 85.11       | ]             | (65) |
| inclu    | ide (57)              | m in calo     | culation  | of (65)m     | only if c      | ylinde  | r is in the      | dwelling       | or hot w      | ater is f           | rom com      | munity h    | -<br>neating  |      |
| 5. Int   | ternal g              | ains (see     | e Table   | 5 and 5a     | ):             |         |                  |                |               |                     |              |             |               |      |
| Metab    | olic daii             | ns (Table     | e 5). Wa  | itts         | ,              |         |                  |                |               |                     |              |             |               |      |
|          | Jan                   | Feb           | Mar       | Apr          | May            | Ju      | n Jul            | Aug            | Sep           | Oct                 | Nov          | Dec         |               |      |
| (66)m=   | 84.21                 | 84.21         | 84.21     | 84.21        | 84.21          | 84.2    | 1 84.21          | 84.21          | 84.21         | 8 <mark>4.21</mark> | 84.21        | 84.21       |               | (66) |
| Lightin  | g gains               | ,<br>(calcula | ted in A  | ppendix      | L, equat       | ion L9  | or L9a), a       | lso see        | Table 5       |                     |              |             |               |      |
| (67)m=   | 17.77                 | 15.79         | 12.84     | 9.72         | 7.27           | 6.13    | 6.63             | 8.62           | 11.56         | 14.68               | 17.14        | 18.27       |               | (67) |
| Applia   | nces ga               | ains (calc    | ulated i  | n Appen      | dix L, eq      | uation  | L13 or L1        | 3a), also      | see Ta        | ble 5               |              |             | 1             |      |
| (68)m=   | 146.71                | 148.24        | 144.4     | 136.23       | 125.92         | 116.2   |                  | 108.24         | 112.07        | 120.24              | 130.55       | 140.24      |               | (68) |
| Cookir   | ng gains              | s (calcula    | ted in A  |              | L. equat       | ion L'  | 5 or L15a        | ), also s      | ee Table      | 5                   |              |             | 1             |      |
| (69)m=   | 31.42                 | 31.42         | 31.42     | 31.42        | 31.42          | 31.4    |                  | 31.42          | 31.42         | 31.42               | 31.42        | 31.42       |               | (69) |
| Pumps    | and fa                | ins gains     | (Table    | 5a)          |                |         |                  |                |               |                     |              |             |               |      |
| (70)m=   | 0                     | 0             | 0         | 0            | 0              | 0       | 0                | 0              | 0             | 0                   | 0            | 0           | ]             | (70) |
| Losses   | se.a.e                | vaporatic     | n (nega   | ative valu   | ı<br>les) (Tab | le 5)   |                  | I              | 1             | <u> </u>            | 1            | I           | 1             |      |
|          | -67.37                | <u> </u>      | <u> </u>  | 1            | -67.37         | -67.3   | 7 -67.37         | -67.37         | -67.37        | -67.37              | -67.37       | -67.37      | ]             | (71) |
|          |                       | ı<br>gains (T |           |              | ļ              |         |                  |                | 1             | <b></b>             | 1            |             | 1             |      |
| (72)m=   | 116.11                | 114.39        | 110.83    | 1            | 102.85         | 98.4    | 3 94.67          | 99.49          | 101.2         | 106.21              | 111.86       | 114.4       | 1             | (72) |
|          |                       | l gains =     | I         |              |                | (       | <br>66)m + (67)m | L<br>1 + (68)m |               |                     |              | I           | 1             |      |
| (73)m=   | 328.86                |               | 316.34    | 300.21       | 284.31         | 269.0   |                  | 264.6          | 273.1         | 289.39              | 307.81       | 321.17      | 1             | (73) |
|          | lar gain              | 1             |           |              |                |         |                  |                |               |                     |              | -           |               | · ,  |
|          |                       |               | using sol | ar flux from | Table 6a       | and ass | ociated equa     | ations to c    | onvert to th  | ne applicat         | ole orientat | ion.        |               |      |
| Orienta  | ation:                | Access F      | actor     | Area         | l              | F       | lux              |                | g_            |                     | FF           |             | Gains         |      |
|          |                       | Table 6d      |           | m²           |                | -       | able 6a          | 1              | Table 6b      | Т                   | able 6c      |             | (W)           |      |
| Southe   | ast <mark>0.9x</mark> | 0.77          | )         | 2.4          | 47             | ×       | 36.79            | x              | 0.63          | x                   | 0.1          | =           | 3.98          | (77) |
| Southe   | ast <mark>0.9x</mark> | 0.77          | ,         | 2.4          | 47             | × 🗌     | 62.67            | × [            | 0.63          |                     | 0.1          | =           | 6.77          | (77) |
| Southe   | ast <mark>0.9x</mark> | 0.77          | ,         | 2.4          | 47             | × 🗌     | 85.75            | × [            | 0.63          |                     | 0.1          | =           | 9.27          | (77) |
| Southe   | ast <mark>0.9x</mark> | 0.77          |           | 2.4          | 47             | × 🗌     | 106.25           | × [            | 0.63          |                     | 0.1          | =           | 11.48         | (77) |
| Southe   | ast <mark>0.9x</mark> | 0.77          | >         | 2.4          | 47             | x       | 119.01           | × [            | 0.63          | × [                 | 0.1          | =           | 12.86         | (77) |

| Southeast 0.9x                         | 0.77         | x                 | 2.47         | x               | 1                | 18.15     | ×           | 0.63         | x                   | 0.1          | =        | 12.77 | (77) |
|--|--------------|-------------------|--------------|-----------------|------------------|-----------|-------------|--------------|---------------------|--------------|----------|-------|------|
| Southeast 0.9x                         | 0.77         | x                 | 2.47         | ×               | 1                | 13.91     | x           | 0.63         | x                   | 0.1          | =        | 12.31 | (77) |
| Southeast 0.9x                         | 0.77         | x                 | 2.47         | x               | 1                | 04.39     | x           | 0.63         | x                   | 0.1          | =        | 11.28 | (77) |
| Southeast 0.9x                         | 0.77         | x                 | 2.47         | x               | ę                | 92.85     | x           | 0.63         | x                   | 0.1          | =        | 10.03 | (77) |
| Southeast 0.9x                         | 0.77         | x                 | 2.47         | ×               | 6                | 69.27     | x           | 0.63         | x                   | 0.1          | =        | 7.48  | (77) |
| Southeast 0.9x                         | 0.77         | x                 | 2.47         | ×               | 2                | 14.07     | x           | 0.63         | x                   | 0.1          | =        | 4.76  | (77) |
| Southeast 0.9x                         | 0.77         | x                 | 2.47         | ×               | 3                | 31.49     | x           | 0.63         | x                   | 0.1          | =        | 3.4   | (77) |
| Southwest0.9x                          | 0.77         | x                 | 10.8         | ×               | 3                | 36.79     | 1 I         | 0.63         | x                   | 0.1          | =        | 17.35 | (79) |
| Southwest0.9x                          | 0.77         | x                 | 10.8         | ×               | 6                | 62.67     | ĪĪ          | 0.63         | x                   | 0.1          | =        | 29.55 | (79) |
| Southwest0.9x                          | 0.77         | ×                 | 10.8         | ×               | 8                | 35.75     | ĪĪ          | 0.63         | x                   | 0.1          | =        | 40.43 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77         | x                 | 10.8         | ×               | 1                | 06.25     | i i         | 0.63         | ×                   | 0.1          | =        | 50.1  | (79) |
| Southwest <sub>0.9x</sub>              | 0.77         | x                 | 10.8         | ×               | 1                | 19.01     | i i         | 0.63         | x                   | 0.1          | =        | 56.12 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77         | ×                 | 10.8         | ×               | 1                | 18.15     | i i         | 0.63         | ×                   | 0.1          | =        | 55.71 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77         | ×                 | 10.8         | <b>-</b> ×      | 1                | 13.91     | i i         | 0.63         | ×                   | 0.1          | =        | 53.71 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77         | ×                 | 10.8         | × آ             | 1                | 04.39     | i i         | 0.63         | ×                   | 0.1          | =        | 49.22 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77         | ×                 | 10.8         | <b>-</b> ×      |                  | 92.85     | i i         | 0.63         | - x                 | 0.1          | =        | 43.78 | (79) |
| Southwest <sub>0.9x</sub>              | 0.77         | ×                 | 10.8         | × آ             | 6                | 69.27     | i i         | 0.63         | ×                   | 0.1          | =        | 32.66 | (79) |
| Southwest0.9x                          | 0.77         | ×                 | 10.8         | ×               |                  | 14.07     |             | 0.63         | x                   | 0.1          | =        | 20.78 | (79) |
| Sout <mark>hwest<sub>0.9x</sub></mark> | 0.77         | ۲×                | 10.8         | ۲ ×             |                  | 31.49     | i i         | 0.63         | x                   | 0.1          | -        | 14.85 | (79) |
|  |              |                   |              |                 |                  |           |             |              |                     |              |          |       |      |
| Solar gains in                         | watts calc   | ulated            | for each m   | onth            |                  |           | (83)m       | = Sum(74)m . | (82)m               |              |          |       |      |
| (83)m= 21.32                           |              | 49.7              |              | 3.98            | 68.48            | 66.02     | 60.         |              | 4 <mark>0.15</mark> | 25.54        | 18.25    |       | (83) |
| Total gains –                          | internal and | l solar           | (84)m = (73  | 3)m +           | (83)m            | , watts   |             |              |                     |              |          | 1     |      |
| (84)m= 350.18                          | 363 3        | 66.04             | 361.79 35    | 3.28            | 337.54           | 325.34    | 325.        | .11 326.91   | 329.54              | 333.36       | 339.42   |       | (84) |
| 7. Mean inte                           | rnal temper  | ature (           | (heating sea | ason)           |                  |           |             |              |                     |              |          |       |      |
| Temperature                            |              |                   |              | · · · ·         | area             | from Tab  | ble 9.      | Th1 (°C)     |                     |              |          | 21    | (85) |
| Utilisation fa                         | -            | • •               |              |                 |                  |           | ,           | ( )          |                     |              |          |       |      |
| Jan                                    | Feb          | Mar               |              | May             | Jun              | Jul       | A           | ug Sep       | Oct                 | Nov          | Dec      | ]     |      |
| (86)m= 0.97                            |              | 0.91              |              | .66             | 0.47             | 0.33      | 0.3         | <u> </u>     | 0.77                | 0.93         | 0.98     |       | (86) |
| Mean interna                           |              | ure in l          | iving area 1 |                 | ow sto           | ne 3 to 7 | I<br>7 in T |              |                     | 1            | <u> </u> | 1     |      |
| (87)m= 20.81                           | <u> </u>     | 20.92             |              | 21              | 21               | 21        | 21          |              | 20.99               | 20.91        | 20.8     | 1     | (87) |
|  | II           |                   |              |                 |                  |           |             |              | 20100               |              | 20.0     | J     |      |
|  | <u> </u>     | ating po<br>20.51 | i            | st of d<br>).52 | 20.53            | 1         | 1           |              | 20.52               | 20.52        | 20.51    | 1     | (88) |
| (88)m= 20.51                           | 20.51 2      | 20.51             | 20.52 20     | 0.52            | 20.53            | 20.53     | 20.8        | 53 20.52     | 20.52               | 20.52        | 20.51    |       | (00) |
| Utilisation fa                         | <u> </u>     | ī                 |              | <u> </u>        |                  | 1         | 1           |              |                     |              |          | 1     |      |
| (89)m= 0.97                            | 0.95         | 0.9               | 0.79 0       | .62             | 0.43             | 0.3       | 0.3         | 1 0.49       | 0.74                | 0.92         | 0.97     |       | (89) |
| Mean interna                           | al temperatu | ure in t          | he rest of d | wellin          | g T2 (f          | ollow ste | eps 3       | to 7 in Tabl | e 9c)               |              | -        | _     |      |
| (90)m= 20.26                           | 20.33 2      | 20.42             | 20.5 20      | ).52            | 20.53            | 20.53     | 20.         | 53 20.52     | 20.51               | 20.41        | 20.25    |       | (90) |
|  |              |                   |              |                 |                  |           |             |              |                     |              |          |       |      |
| L                                      |              | I                 | I            |                 |                  |           |             | f            | LA = Liv            | ing area ÷ ( | 4) =     | 0.47  | (91) |
| Mean interna                           | 1 1          | ļ                 | r the whole  | dwelli          | ng) = f          |           | + (1        |              | LA = Liv            | ing area ÷ ( | 4) =     | 0.47  | (91) |
| Mean interna<br>(92)m= 20.52           | al temperatu | ļ                 |              | dwelli          | ng) = f<br>20.75 |           | + (1        | – fLA) × T2  | LA = Liv<br>20.73   |              | 4) =     | 0.47  | (91) |

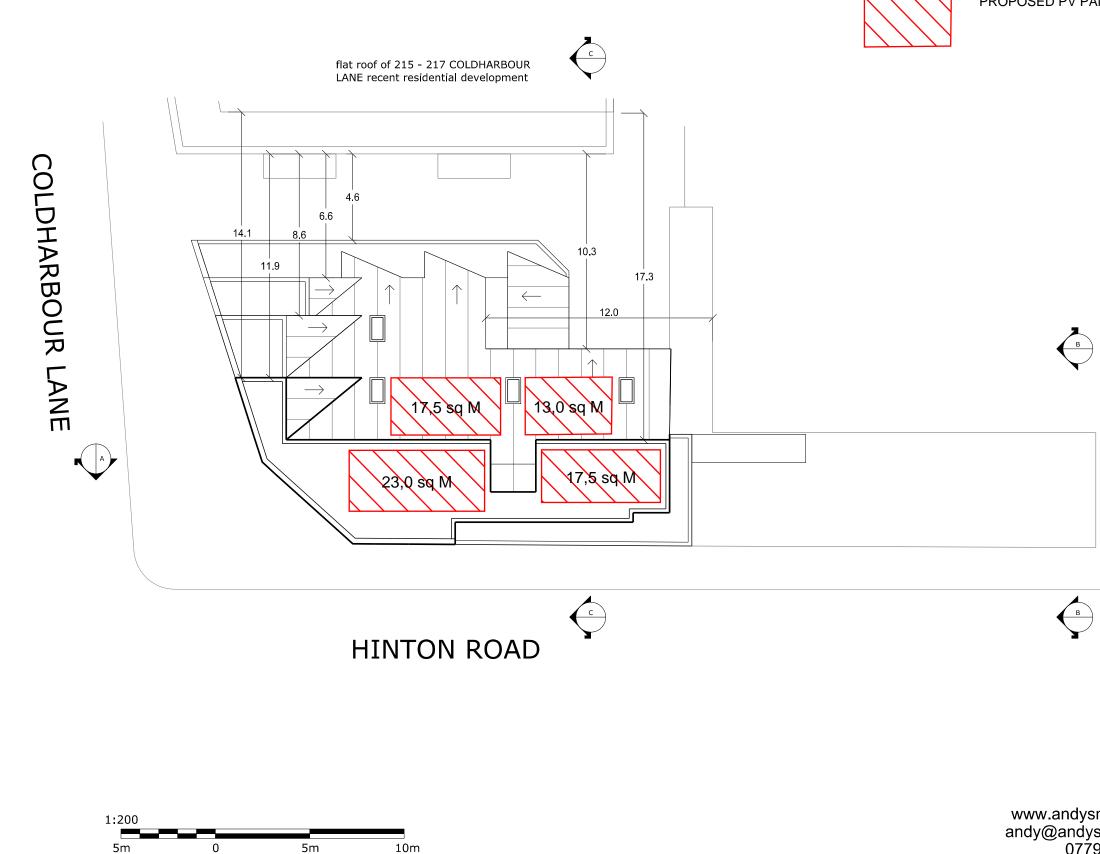
Apply adjustment to the mean internal temperature from Table 4e, where appropriate

|  |                             |           | 1                     |               |            | 1                         |           | 1         |            | 1                   | 1            |             |           |        |
|--|-----------------------------|-----------|-----------------------|---------------|------------|---------------------------|-----------|-----------|------------|---------------------|--------------|-------------|-----------|--------|
| (93)m=   | 20.52                       | 20.58     | 20.66                 | 20.72         | 20.74      | 20.75                     | 20.75     | 20.75     | 20.75      | 20.73               | 20.65        | 20.51       |           | (93)   |
|  |                             |           | uirement              |               | ro obtoir  |                           | on 11 of  |           |            | tTim (              | 76)m.on      | d ro oolo   | vilata    |        |
|  |                             |           | or gains              | •             |            | ieu al sie                | эрттог    | Table 9   | 0, so ina  | u 11,m=(            | 70)m an      | d re-calc   | ulate     |        |
|  | Jan                         | Feb       | Mar                   | Apr           | May        | Jun                       | Jul       | Aug       | Sep        | Oct                 | Nov          | Dec         |           |        |
| Utilisa  | ation fac                   | tor for g | ains, hm              | :             | <u>`</u>   |                           |           |           | :          |                     | <b>I</b>     |             |           |        |
| (94)m=   | 0.97                        | 0.95      | 0.9                   | 0.8           | 0.64       | 0.45                      | 0.31      | 0.33      | 0.5        | 0.76                | 0.92         | 0.97        |           | (94)   |
| Usefu  |                             | hmGm      | , W = (94             | 4)m x (84     | 4)m        | -                         |           |           |            | 1                   |              |             |           |        |
| (95)m=   | 338.57                      | 344.02    | 330.62                | 288.94        | 225.52     | 151.46                    | 102.2     | 106.8     | 164.75     | 249.44              | 306.94       | 330.09      |           | (95)   |
|  | · ·                         |           | ernal tem             | r <u> </u>    | i          | r                         |           |           |            |                     |              | · · · · · · |           |        |
| (96)m=   | 4.3                         | 4.9       | 6.5                   | 8.9           | 11.7       | 14.6                      | 16.6      | 16.4      | 14.1       | 10.6                | 7.1          | 4.2         |           | (96)   |
|  |                             |           | i                     | · · ·         | i          | Lm , W =                  | - ,       | 1 · · · · |            | r <del>ī</del>      | 244.20       | 442.52      |           | (07)   |
| (97)m=   | 416.48                      | 401.35    | 361.22                | 296.95        | 226.39     | 151.48<br>Wh/mon1         | 102.2     | 106.8     | 164.82     | 253.71              | 341.39       | 413.52      |           | (97)   |
| (98)m=   | 57.96                       | 38.53     | 22.77                 | 5.77          | 0.65       | 0                         | n = 0.02  |           | 0          | 3.18                | 24.81        | 62.07       |           |        |
| (00)11-  | 07.00                       | 00.00     | 22.11                 | 0.11          | 0.00       | Ŭ                         | 0         | -         | -          |                     | r) = Sum(9   |             | 215.73    | (98)   |
| Creek  | . h tin                     |           |                       | L-\ \ /b /m-? |            |                           |           | 1010      | i per yeur | (ittiniyou          | r) – Oun(0   | 0,15,912 -  |           | 4      |
|  |                             | • •       | ement in              |               | •          |                           |           |           |            |                     |              | [           | 4.33      | (99)   |
|  |                             |           |                       |               |            | scheme                    |           |           |            |                     |              |             |           |        |
|  |                             |           |                       |               |            | ing or wa<br>nentary l    |           |           |            |                     | unity sch    | neme.       | 0         | (301)  |
|  |                             |           |                       |               |            |                           | -         |           | 1) 0 111   | one                 |              |             |           |        |
|  |                             |           |                       |               |            | 1 – (301                  |           |           |            |                     |              |             | 1         | (302)  |
|  | -                           |           |                       |               |            | rces. The p<br>from power |           |           |            | up to four          | other heat   | sources; tl | he latter |        |
|  |                             |           | Commun                |               |            | · · · · <i>p</i> · · · ·  |           |           |            |                     |              | [           | 1         | (303a) |
| Fractio  | n of tota                   | al space  | heat fro              | m Comn        | nunity he  | eat pump                  |           |           |            | (3                  | 02) x (303   | a) =        | 1         | (304a) |
|  |                             |           |                       |               |            | 4c(3)) fo                 |           | unitv hea | atina svs  |                     |              |             | 1         | (305)  |
|  |                             |           |                       |               |            | ity heatir                |           |           | 5-7-       |                     |              |             | 1         | (306)  |
|  | heating                     |           |                       | 20,1010       | Johnnan    | ity noath                 | ig oyoto  |           |            |                     |              | l           | kWh/yea   | ` ´ ´  |
| •  |                             | -         | requirem              | nent          |            |                           |           |           |            |                     |              |             | 215.73    |        |
| Space  | heat fro                    | m Comi    | nunity h              | eat pum       | р          |                           |           |           | (98) x (30 | 04a) x (30          | 5) x (306)   | =           | 215.73    | (307a) |
| Efficier   | ncy of se                   | econdar   | y/supple              | mentary       | heating    | system                    | in % (fro | om Table  | e 4a or A  | ppendix             | E)           |             | 0         | (308   |
| Space  | heating                     | require   | ment fro              | m secon       | dary/sup   | oplemen                   | tary syst | tem       | (98) x (30 | 01) x 100 ·         | ÷ (308) =    |             | 0         | (309)  |
|  |                             |           |                       |               |            |                           |           |           |            |                     |              | I           |           |        |
|  | <b>heating</b><br>I water I |           | equirem               | ent           |            |                           |           |           |            |                     |              | [           | 1846.5    |        |
|  |                             |           | ty schem<br>nunity he |               | C          |                           |           |           | (64) x (30 | 03a) x (30          | 5) x (306) : | =           | 1846.5    | (310a) |
| Electric   | city use                    | d for hea | at distribu           | ution         |            |                           |           | 0.01      | × [(307a). | (307e) <del>+</del> | + (310a)…(   | (310e)] =   | 20.62     | (313)  |
| Cooling  | g Systei                    | n Energ   | y Efficie             | ncy Rati      | 0          |                           |           |           |            |                     |              |             | 0         | (314)  |
| Space cooling (if there is a fixed cooling system, if not enter 0) $= (107) \div (314) = 0$ (33) |                             |           |                       |               |            |                           |           |           |            |                     |              |             | (315)     |        |
| Electric   | city for p                  | oumps a   | nd fans v             | within dv     | velling (1 | Table 4f)                 | :         |           |            |                     |              | I           |           |        |
|  |                             |           |                       |               |            | sitive in                 |           | outside   |            |                     |              |             | 116.96    | (330a) |
|  |                             |           |                       |               |            |                           |           |           |            |                     |              |             |           |        |

| warm air heating system fans   |                             | 0          | (330b) |
|--|-----------------------------|------------|--------|
| pump for solar water heating   |                             | 0          | (330g) |
| Total electricity for the above, kWh/year                              | =(330a) + (330b) + (330g) = | 116.96     | (331)  |
| Energy for lighting (calculated in Appendix L)                         |                             | 313.91     | (332)  |
| Electricity generated by PVs (Appendix M) (negative quantity)          |                             | -664.99    | (333)  |
| Electricity generated by wind turbine (Appendix M) (negative quantity) |                             | 0          | (334)  |
| 12b. CO2 Emissions – Community heating scheme                          |                             |            |        |
| <b>F</b> -   | arms Emission feator        | Emissions. |        |

|   | Energy<br>kWh/year          | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |        |
|---|-----------------------------|-------------------------------|--------------------------|--------|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) If there is CHP usin | g two fuels repeat (363) to | (366) for the second fu       | el 364                   | (367a) |
| CO2 associated with heat source 1 [(307b)+  | -(310b)] x 100 ÷ (367b) x   | 0.52                          | = 294.04                 | (367)  |
| Electrical energy for heat distribution   | [(313) x                    | 0.52                          | = 10.7                   | (372)  |
| Total CO2 associated with community systems   | (363)(366) + (368)(372      | )                             | = 304.74                 | (373)  |
| CO2 associated with space heating (secondary)   | (309) x                     | 0                             | = 0                      | (374)  |
| CO2 associated with water from immersion heater or instantant   | eous heater (312) x         | 0.52                          | = 0                      | (375)  |
| Total CO2 associated with space and water heating   | (373) + (374) + (375) =     |                               | 304.74                   | (376)  |
| CO2 associated with electricity for pumps and fans within dwell   | ing (331)) x                | 0.52                          | = 60.7                   | (378)  |
| CO2 associated with electricity for lighting  | (332))) ×                   | 0.52                          | = 162.92                 | (379)  |
| Energy saving/generation technologies (333) to (334) as applic<br>Item 1  | able                        | 0.52 x 0.01 =                 | -345.13                  | (380)  |
| Total CO2, kg/year sum of (376)(382) =  |                             |                               | 183.23                   | (383)  |
| Dwelling CO2 Emission Rate (383) ÷ (4) =  |                             |                               | 3.68                     | (384)  |
| El rating (section 14)  |                             |                               | 97.41                    | (385)  |

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## **P5.08**

PROPOSED PV PANAL ARRAY

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