Pivotal International

Energy & Sustainability Statement

For

219-223 Coldharbour Lane, Loughborough Junction, London

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Client:
Coldharbour Lane Ltd,
c/o Rossmore Properties Investments Ltd,
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Contents

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^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 78.5m2 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 78.5m2 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_2 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_2 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	-
	(Tonnes CO_2)	
Cumulative savings for off-set 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**
Mayor's Priorities 1. 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. 2. Through both their Local plans and planning decisions, boroughs should aim for 100% of development to be delivered on previously developed land. 3. Developers should optimise the scale and density of their development, considering the local context, to make efficient use of London's limited land	The proposed development will be sited on previously developed land, located within Lambeth. The site is 100% brownfield and no green-field development is proposed. The development will increase density in line with Mayor's principle: *'Make best use of all developable land by increasing density'.* The building design will ensure that the use of floor space is optimised, balancing the need to create a building with sufficient floor area, whilst ensuring that the building design/massing is in keeping with the surrounding buildings. The design team's aspiration is to create a building with a high quality internal environment, with the inclusion of private outdoor spaces. The development proposals will provide new active frontage. The development is located in an area with excellent public transport connections which are able to support the increase in density on the site. There are a number of issues which have been taken into account by the design team when determining the height and massing, and therefore density of the proposed buildings. These include privacy; light pollution and shadowing issues to the neighboring buildings; micro-climatic effects are mainly determined by constraints of the existing buildings and surroundings.

Basements and Lightwells	Development Response
Mayor's Priorities 1. When planning a basement development, developers should consider the geological and hydrological conditions of the site and surrounding area, proportionate to the local conditions, the size of the basement and lightwell and the sensitivity of adjoining buildings and uses, including green infrastructure. 2. When planning and constructing a basement development, developers should consider the amenity of neighbors. **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.	Basements do not form part of the design for this application.
Local food growing	**Development Response**
Mayor's Priorities 1. To protect existing established food growing spaces. **Mayor's Best Practice** 1. To provide space for individual or communal food growing, where possible and appropriate. 2. To take advantage of existing spaces to grow food, including adapting temporary spaces for food growing.	The dwellings will be provided with high quality amenity space in the form of a roof garden that could give opportunity for individual food growth along with private balconies to upper floor residential units, which is consistent with such a central London location.

4.2 SPG section 2.3: Site layout and design	
Site layout and design	**Development Response**
Mayor's Priorities 1. The design of the site and building layout, footprint, scale and height of buildings as well as the location of land uses should consider: 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; • access routes to public transport and other facilities that minimise the use of public transport; • New design of development • the existing landform; • the potential to take advantage of natural systems such as wind, sun and shading; • the principles sets out London Plan policies 7.1 and 7.6; • the potential for adaption and reuse in the future; • potential for incorporating green infrastructure; • potential for incorporating open space, recreation space, child play space; • energy demands and the ability to take advantage of natural systems and low and zero carbon energy sources; • site wide infrastructure; • access to low carbon transport modes; • potential to address any local air • quality, noise disturbance, flooding and land contamination issues; and • The potential effect on the microclimate.	Works will involve retaining the existing primary building structure with refurbishment of the building fabric in line with current Part L requirements. Areas of soft landscaping will be incorporated via the roof terrace. There are a number of issues which have been taken into account by the design team when determining the height and massing of the proposed building. These include privacy, light pollution and overshadowing issues to the neighboring buildings, consideration of micro-climatic effects due to wind flow, and the limitations created by new and existing underground services and utilities. 219-223 Coldharbour is located within easy walking distance of numerous public transport links. The site is located adjacent to several bus stops with main bus routes running along Coldharbour Lane. The site is also within walking distance of Loughborough Junction & Brixton rail stations offering transport links to the North and South of London. A Transport Statement has been produced and will form part of the overall planning submission. The following long stay cycle parking has been provided at Ground Floor level which meets London Plan 2016 standards: • Two Tier racks containing 4 spaces for Shop/Office occupants • Two Tier racks containing 19 spaces for residential use A Santander Cycle Hire docking station is located 2km to the West of the site at Stockwell Underground Station. At present the development strategy has been designed to align with current market demands in this particular area of London. 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. Façade 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

	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. 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. The Proposed Development recognises that for new buildings to be considered useable for at least the next 60 years, a considerable level of future flexibility will need to be incorporated into the design. The building environmental services strategy has been based on the need to accommodate possible future scenarios into the proposed redevelopment including: • Advances in technology, including energy supply and conservation such as the gradual roll out of the Pimlico district network, retrofit of fuel cells, or possible bio-fuel infrastructure; • Climate change, including the predicted increases in both external temperature and intensity of rainfall over the coming decades; • Increase in transient nature of business practice • Market sector demand; • Requirement of different types of tenant and usage flexibility within the dwelling/use type.
4.3 Energy and carbon dioxide emissions (SPG section 2.4)	
Energy and carbon dioxide emissions	**Development Response**
Mayor's Priorities 1. The overall carbon dioxide emissions from a development should be minimised through the implementation of the energy hierarchy set out in London Plan policy 5.2. 2. Developments should be designed to meet the following Regulated carbon dioxide standards, in line with London Plan policy 5.2.	An Energy Statement has been prepared to detail the energy strategy for the Proposed Development and is submitted as part of this Energy & Sustainability Statement see Section 3.0 above and Appendix A below. **Energy Statement:** In accordance with Lambeth Council's policy the proposed redevelopment aspires to deliver a

Residential buildings Year Improvements beyond 2010 Building Regulations 1st October 2013 to 2016 40 per cent (or 35% below 2013 Building Regulations) 2016 to 2031 - Zero carbon **Non-domestic buildings** Year Improvements beyond 2010 Building Regulations 1st October 2013 to 2016 40 per cent (or 35% below 2013 Building Regulations) 2016 – 2019 As per the Building Regulation requirements 2019 to 2031 Zero carbon **Mayor's Best Practice** 1. Developments should contribute to ensuring resilient energy infrastructure and a reliable energy supply, including from local low and zero carbon sources. 2. Developers are encouraged to include innovative low and zero carbon technologies to minimise carbon dioxide emissions within developments and keep up to date with rapidly improving technologies.	minimum on-site carbon dioxide emissions (CO_2) 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_2 reduction will be made up of the following anticipated key contributions: Energy efficiency measures Low Temperature Centralised Communal Heating Network.
Energy demand assessment	**Development Response**
Mayor's Priorities 1. Development applications are to be accompanied by an energy demand assessment.	An energy statement has been prepared to detail the energy strategy for the Proposed Development and is submitted as part of this energy & Sustainability Statement, see Appendix A. This document includes an energy demand assessment following the approach to energy statements as detailed in the 'Energy Planning - GLA Guidance on preparing energy assessments' document.
Use less energy	**Development Response**
Mayor's Priorities 1. The design of developments should prioritise passive measures.	In line with the energy hierarchy set in the London Plan, the demand reducing measures set out in the Energy Statement was incorporated in the

Mayor's Best Practice 1. Developers should aim to achieve Part L 2013 Building Regulations requirements through design and energy efficiency alone, as far as is practical.	design with priority given to passive measures including the fabric first principals: • Maximising air-tightness. • Using Super-high insulation. • Optimising solar gain through the provision of 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 1. Where borough heat maps have identified district heating opportunities, boroughs should prepare more detailed Energy Master Plans (EMPs) to establish the extent of market competitive district heating networks. 2. Developers should assess the potential for their development to: connect to an existing district heating or cooling network; expand an existing district heating or cooling network, and connect to it; or Establish a site wide network, and enable the connection of existing buildings in the vicinity of the development. 3. Where opportunities arise, developers generating energy or waste heat should maximise long term carbon dioxide	Existing and planned heat networks and anchor heat loads in the vicinity of the site have considered for the potential connection to the site, but no immediate viable opportunities for connection were identified for the Pimlico Heat Network Scheme. The Proposed Development will be served by a community heating system which enables connection to any future heat networks in the vicinity of the site. The community heating system consist of a LTHP Air Source Heat Pump ASHP located in a central plant room to supply the space heating and DHW requirements. 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. Capped off connections are proposed to the boundary of the site enable connectivity to district or local heat network when such an option becomes

savings by feeding the decentralised energy network with low or zero carbon hot water, and where required, cold water.	available and viable.
4.4 Renewable energy (SPG section 2.5)	
Renewable energy	**Development Response**
Mayor's Priorities 1. Boroughs and neighborhoods should identify opportunities for the installation of renewable energy technologies in their boroughs and neighborhoods. 2. Major developments should incorporate renewable energy technologies to minimise overall carbon dioxide emissions, where feasible.	A feasibility study has been undertaken to determine what is deemed the most appropriate renewable energy source for the development (for more details please refer to the Energy Statement included in Appendix A herein). The integration of living roof and PV panels to create a bio-solar roof is proposed for the development. The PV array will provide renewable electricity to the development. The PV layout has made use of the available roof area limited due to the form and massing of the building whilst providing consideration to the application of a roof terrace and local screened plant area and parapet.
Carbon dioxide off-setting	**Development Response**
Mayor's Priorities 1. Boroughs should establish a carbon dioxide off-set fund and identify suitable projects to be funded. 2. 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	The current energy prediction results in the site wide 82% CO_2 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
Mayor's Priorities 1. Boroughs should set out policies to encourage the retrofitting of carbon dioxide and water saving measures in their borough. 2. Where works to existing developments are proposed developers should retrofit carbon dioxide and water saving measures.	The proposed design will incorporate CO_2 and water savings measures as detailed elsewhere in this document.
Monitoring energy use	**Development Response**
Mayor's Priorities 1. Developers are encouraged to incorporate monitoring equipment and systems where appropriate to enable occupiers to monitor and reduce their energy use.	Extensive submetering will be present to allow monitoring as well as separate billing of individual tenancies. Energy display devices will be provided in the dwellings in line with the equivalent requirement of the deregulated Code for Sustainable Homes criteria.
Supporting a resilient energy supply	**Development Response**
Mayor's Priorities 1. Developers are encouraged to incorporate equipment that would enable their schemes to participate in demand side response opportunities.	The proposed development overall energy demand has been minimised through the implementation of the sustainable design measures outlined in this statement; this will reduce overall impact on the wider energy network. The development will also be provided with comprehensive sub-metering and smart meters to allow better management of the energy demand and better response to wider network energy availability through the central BMS system.
4.5 Water efficiency (SPG section 2.6)	
Water efficiency	**Development Response**
Mayor's Priorities 1. Developers should maximise the opportunities for water saving measures and appliances in all developments, including the reuse and using alternative sources of water.	The re-development recognises that the threat of future water shortage is a serious issue for London. Water efficiency and recycling has been made a key priority in the design by incorporating the following water efficiency elements: • Reduce mains water consumption on site

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

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 *The Green Guide* 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.	Where new materials are required: Materials will be chosen that have a minimal environmental impact, are from sustainable or recycled sources and, where feasible, are locally sourced to reduce transportation impacts, prioritising the following factors: • *Life cycle costing (£ and CO2)* • *Use renewable materials* • *Source materials locally* • *Recycled content* • *Minimise waste to landfill* • *Specification of materials with zero exotoxins* • *Synthetic or non-sustainably-sourced materials to be minimised* • *Off-site manufacturing* • *Ethical sourcing* • *Minimise embodied energy* • *Design for Disassembly* • *Recyclability of materials* • *Design mechanical fixings to facilitate deconstruction* • *Specify materials and plant that can be re-used* • *Lowest available embodied carbon option MEP Materials Specification* • *Minimise gluing and composite materials* The project team will target the use of materials selected in accordance with The Green Guide to Specification, a measure of environmental impact of the material over its lifetime. The selection of A+ and A-rated materials will be prioritised and feed in to the BREEAM credit scores. The team will endeavor to use structural timber from FSC compliant sources. The team will also endeavor to use non-structural timber from a known source with a sustainable purchasing policy, and not be included on the CITES (Convention on International Trade in Endangered Species) list. Insulation materials for building elements and building services will be specified with low embodied environmental impact (minimal global warming potential and zero ozone depleting properties). The opportunity to source construction

	materials from a factory/plant, quarry, railhead or recycling centre close of the site will be investigated, with priority given to use of pre-fabricated elements, where feasible. Locally sourced aggregates and durable materials will be emphasised in the hard landscaping, where feasible. 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. No peat or weathered limestone is to be used in either the buildings or landscaping. The Waste & Resources Action Programme (WRAP) toolkit will be used at design stage to assess how use of recycled and reused materials can be maximised. 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
Construction phase	**Development Response**
Mayor's Priorities 1. Developers should maximise the use of existing resources and materials and minimise waste generated during the demolition and construction process through the implementation the waste hierarchy.	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: • To contribute towards achieving current and long-term government GLA and City of Westminster targets for waste minimisation, recycling and reuse. • To ensure that all legal requirements for the handling and management of operational waste are complied with • To provide tenants with a convenient, clean and efficient waste management systems that

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	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: During Construction: • Site wide waste management plan • Opportunities for prefabrication • Recycling target • Site travel efficiency During Operation: • Sufficiently sized and centralised space for recycling collection • Compactors • Minimise volume of waste to landfill The principle contractor will have responsibility for writing, implementing and updating the Site Waste Management Plan (SWMP) throughout the development process. The SWMP will identify all waste streams and will discuss the potential to reduce, re-use, and recycle all materials wherever possible. This commitment to minimisation will be achieved in a number of ways, including but not limited to, the following: • 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 • Attention to material quantity requirements to avoid over ordering and generation of waste materials • Re-use of materials wherever feasible • Segregation of waste at source where practical • Re-use and re-cycling of materials off-site where re-use on-site is not practical Modular construction / off site prefabrication will be considered delivering benefits: see Appendix 7.1 Recycling collection facilities will be implemented in the building within Ground Floor refuse stores. All waste will be collected from Coldharbour Lane.

	Due to the nature of the existing site where applicable 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.
Occupation phase	**Development Response**
Mayor's Priorities 1. Developers should provide sufficient internal space for the storage of recyclable and compostable materials and waste in their schemes. 2. The design of development should meet borough requirements for the size and location of recycling, composting and refuse storage and its removal.	Recycling facilities will be implemented in the building. Separate residential and commercial waste stores will be provided at ground level, each with separate bins for general waste and recyclables. Commercial bin store includes a compactor with 1280l Eurobins and the remainder bin stores with 1280l Eurobins only to meet Lambeth Council's Waste & Recycling Storage & Collection Requirements (Oct 2013)
4.7 Nature conservation and biodiversity (SPG section 2.8)	
Nature conservation and biodiversity	**Development Response**
Mayor's Priorities 1. There is no net loss in the quality and quantity of biodiversity. 2. Developers make a contribution to biodiversity on their development site.	Due to the constraints of the existing site the landscaping scheme is limited although where feasible and identified will be developed to maximise ecological improvement and provide environmental benefit, with particular focus given in the following areas: Terraces within the development will ensure that there will be a net gain in terms of biodiversity on the site. The site has currently low ecological value and therefore proposed improvements will result on a significant improvement on the biodiversity of the site. Where feasible, vegetation to be planted on the site will have a low water requirement (low maintenance native species and drought resistant species will be specified) and will be selected to improve the habitat for local wildlife and birds. Planting species will be found on the London Biodiversity Action Plan.
4.8 Tackling increase temperature and drought (SPG section 3.2)	
Overheating	**Development Response**

Mayor's Priorities 1. Developers should include measures, in the design of their schemes, in line with the cooling hierarchy set out in London Plan policy 5.9 to prevent overheating over the scheme's lifetime. **Mayor's Best Practice** 1. The design of developments should prioritise landscape planting that is drought resistant and has a low water demand for supplementary watering.	An adaptable façade design and self-shading ability plus glazing selection has been deployed on the scheme to help reduce the impact of unwanted solar gain, which would otherwise increase cooling loads and hence energy consumption in the building, whilst encouraging daylight and providing views. A desktop study was undertaken to understand the projected solar gain, and to mitigate the risk of summertime overheating. As a result, the following solar control performance below has been established for all areas of the development: | | G-Value | | Commercial Areas | 0.5 | | Flats | 0.63 | Effectiveness of the proposed measures has been tested against Part L Building Regulations Criterion 3 for both, residential and commercial areas. In both scenarios compliance is achieved. Internal blinds/curtains can be used to further improve the internal environment during the summer period Where feasible, vegetation to be planted on the site will have a low water requirement (low maintenance native species and drought resistant species will be specified) and will be selected to improve the habitat for local wildlife and birds.
Resilient foundations	**Development Response**
Mayor's Best Practice 1. Developers should consider any long term potential for extreme weather events to affect a building's foundations and to ensure they are robust.	The site does not propose any new trees and new foundations will be incorporated as part of the overall proposal. Any new trees considered will be above ground floor, so can be planted within tree pits which would create the root barriers.

<table>
<tr><th colspan="2">4.9 Increasing green cover and trees (SPG section 3.3)</th></tr>
<tr><th>Urban greening</th><th>Development Response</th></tr>
<tr><td>Mayor’s Priorities
1. Developers should integrate green
infrastructure into development schemes, including by creating links with wider green infrastructure network.

2. Major developments in the Central London Activity Area (CAZ) should be designed to contribute to the Mayor’s target to increase green cover by 5% in this zone by 2030.</td><td>Opportunities for incorporation of green areas have been maximised despite the development being in a dense urban location and constrained by the existing site and building. Additional green coverage will be provided with the incorporation of strategically located planters and soft landscaping. This will be in excess of 5% increase as the existing development has very limited green areas.</td></tr>
<tr><th>Trees</th><th>Development Response</th></tr>
<tr><td>Mayor’s Priorities
1. Developments should contribute to the
Mayor’s target to increase tree cover across London by 5% by 2025.

2. Any loss of a tree/s resulting from development should be replaced with
an appropriate tree or group of trees for
the location, with the aim of providing
the same canopy cover as that provided
by the original tree/s.</td><td>There is no loss of trees anticipated in the development.

Additional tree coverage is restricted by virtue of the existing site and building.

New trees indicated on planning drawings which will be subject to conditions</td></tr>
</table>

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

Flood risk management	Development Response
Mayor's Priorities 1. 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. 2. Developments incorporate the recommendation of the TE2100 plan for the future tidal flood risk management in the Thames estuary 3. 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.	The design of the proposed development has included the potential for climate change increases in flood risk. As a result of the Thames Tidal Defenses, there is not predicted to be any flooding of the site even in the event of climate change-induced increases in flood levels over the next 100 years. Measures to address residual flood risks have been incorporated in the design as described above.
Flood defenses	**Development Response**
Mayor's Priorities 1. Development should maximise all opportunities to achieve an 8m setback on fluvial watercourses between built development and watercourses, flood defenses and culverts. 2. Development should maximise all opportunities to achieve a 16m setback on tidal watercourses between built development and watercourses and flood defenses.	The proposed development is at a significantly greater distance than 16 m from any watercourse or flood defense.
Other sources of flooding	**Development Response**
Mayor's Priorities 1. All sources of flooding need to be considered when designing and constructing developments.	The design has considered all sources of flooding.

4.11 Land contamination (SPG section 4.2)	
Land contamination	**Development Response**
Mayor's Priorities 1. Developers should set out how existing land contamination will be addressed prior to the commencement of their development. 2. Potentially polluting uses are to incorporate suitable mitigation measures.	No land contamination is expected on site. Proposed uses do not represent high polluting risk.
4.12 Air pollution (SPG section 4.3)	
Air pollution	**Development Response**
Mayor's Priorities 1. Developers are to design their schemes so that they are at least 'air quality neutral'. 2. Developments should be designed to minimise the generation of air pollution. 3. Developments should be designed to minimise and mitigate against increased exposure to poor air quality. 4. Developers should select plant that meets the standards for emissions from combined heat and power and biomass plants set out in Appendix 7. 5. 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.	The following factors have been taken into account within the design: Minimise NOx emissions Carbon filters fitted to MVHR systems Reduction of traffic to site by providing cycling facilities. 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. 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: • Two Tier racks containing 4 spaces for Shop/Office occupants • Two Tier racks containing 19 spaces for residential use A Santander Cycle Hire docking station is located 2km to the West of the site at Stockwell Underground Station. KPIs will be set to monitor and reduce 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**
Mayor's Priorities 1. Areas identified as having positive sound features or as being 'quiet areas' should be protected from noise enhanced, where possible. 2. Noise should be reduced at source and then designed out of a scheme to reduce the need for mitigation measures.	The following factors have been prioritised within the design in order to reduce the impact of noise produced within the development, and minimise the negative effect of noise sources arising outside the building: • Optimise deliveries and timings • Attenuation of noise to and from the site • Location in relation to noise sensitive environments • Reduction of traffic to site by providing cycling facilities The local acceleration and breaking of traffic on surrounding roads creates noise and airborne pollution. Noise surveys have been undertaken on the site and concluded that suitable noise levels can be achieved using appropriate façade treatment through insulation, glazing and ventilation arrangements. An initial facade sound insulation assessment has been carried out to determine the required acoustic performance of the facade in order to achieve indoor ambient noise levels as set out by the relevant guidance, and provide guidance on the ventilation strategy. This has informed the design of the facade and associated Building Services. For residential dwellings, the proposed design intent is to improve on Building Regulations (2003) Part E for internal sound transmission standards by 5dB. Furthermore, people will be encouraged to take public transport or cycle to the development, which will contribute towards reducing the local sound and air pollution 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 1. Developments and lighting schemes should be designed to minimise light pollution.	Light pollution will be minimised by considerate selection of external light fittings to avoid light spillage as well as time clock and dusk-to-dawn controls.
4.15 Water pollution (SPG section 4.6)	
Surface water runoff	**Development Response**
Mayor's Priorities 1. In their aim to achieve a greenfield runoff rate developers should incorporate sustainable urban drainage systems (SuDS) into their schemes which also provide benefits for water quality. **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.	The Proposed Development does not represent a significant change to the runoff characteristics of the site. Best practice water management and pollution control will be employed during construction.
Water treatment	**Development Response**
Mayor's Best Practice 1. Residential developments discharging 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	The development will be connected to the public foul sewer.

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_2) 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_2 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_2 reduction against the performance of the existing building, this energy statement predicts the % CO_2 saving beyond a 'New Build' Part L: 2013 compliant equivalent building.

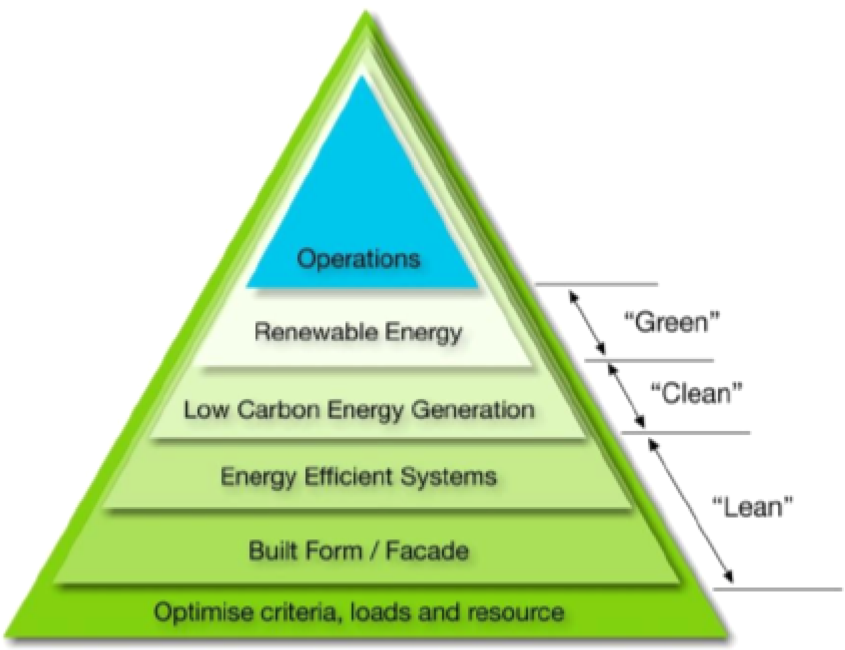
2 Introduction

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_2 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_2 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_2 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_2 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_2 Emissions

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

Gas	0.216	$kgCO_2/kWh$
Grid Supplied Electricity	0.233	$kgCO_2/kWh$
Grid Displaced Electricity	0.233	$kgCO_2/kWh$

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^2K	0.2 W/m^2K
Roof	0.11 W/m^2K	0.15 W/m^2K
Ground Floor	n/a	0.18 W/m^2K
Window incl. frame U-Value	0.73 W/m^2K	1.4 W/m^2K
Glazing g-value	0.63	0.63
Air permeability (dwellings)	3 $m^3/hr/m^2$ @ 50Pa	10 $m^3/hr/m^2$ @ 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_2 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_2 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_2 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:

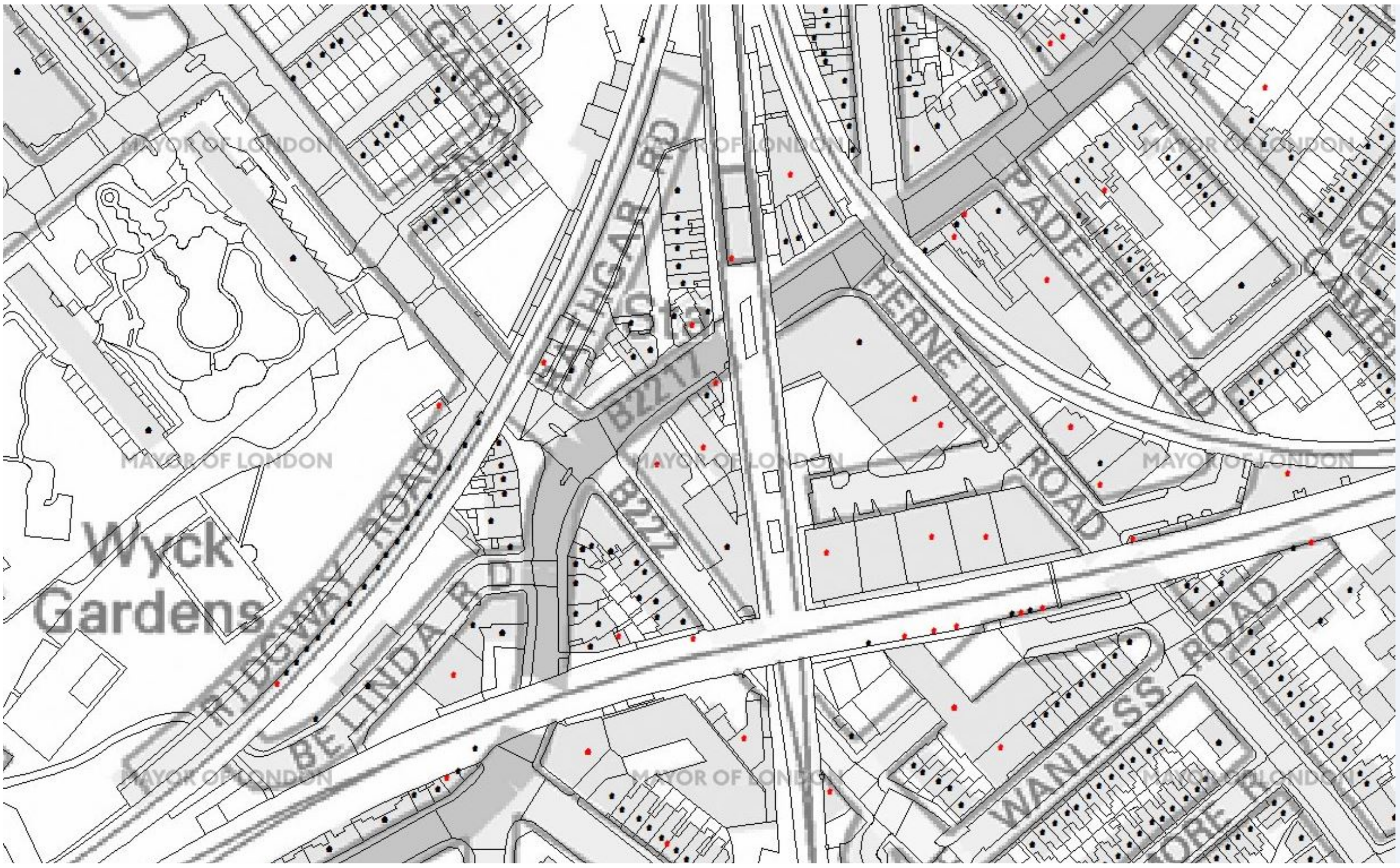
- Connection to existing heat networks beyond the site boundary
- Connection to existing low carbon heat distribution networks including combined heat and power (CHP)
- Providing a site-wide heating network including combined heat and power (CHP)

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

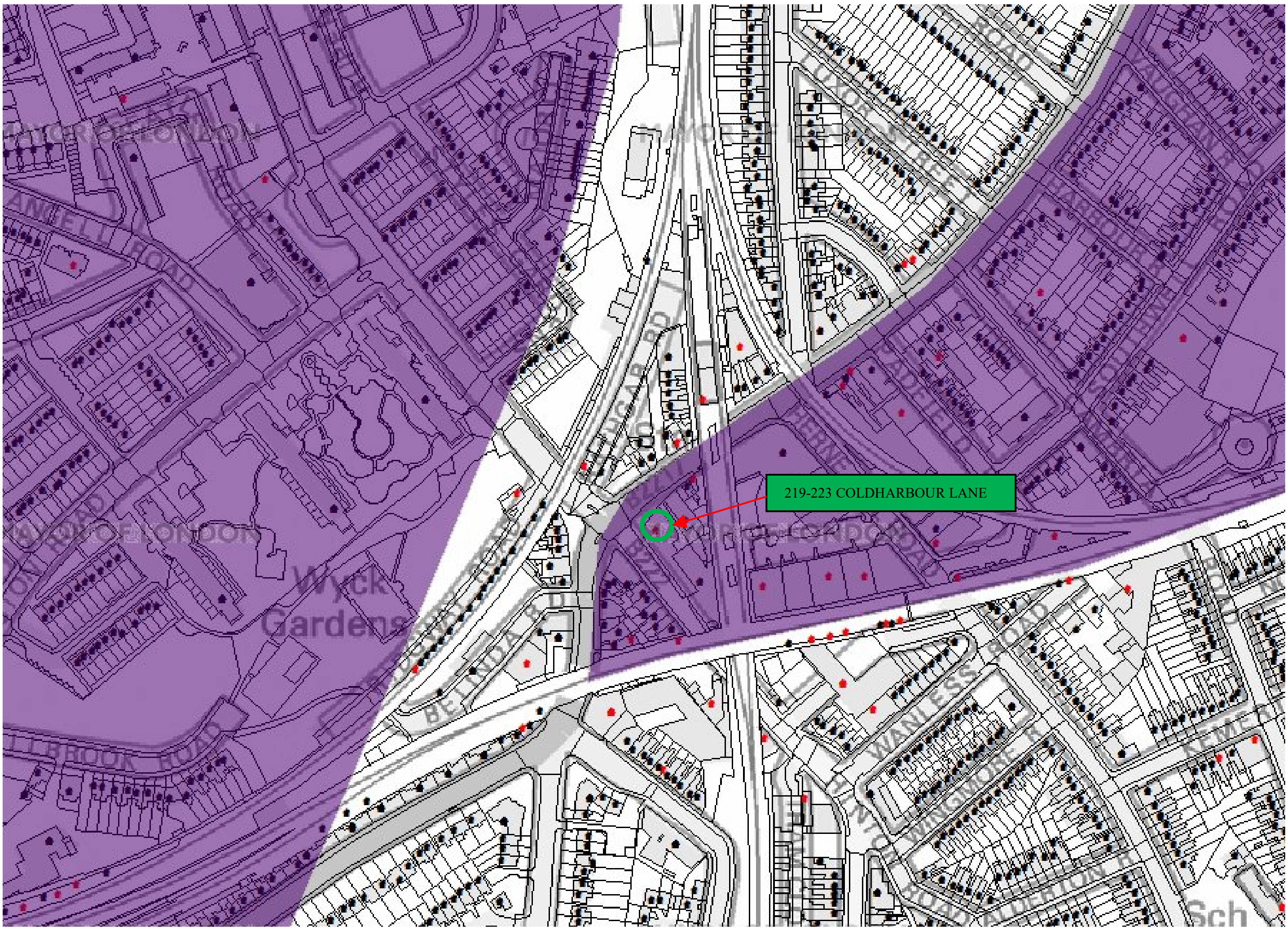
- The centralised LTHW Heat pump system delivered higher CO_2 reductions when modelled against the CHP as there were less distribution losses and reduced demand.
- The Clean Air Strategy published in March has set stringent targets to cut emissions by 2020 and 2030. The goal is to reduce the harm to 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 • Solar photovoltaic	N Y	• Conflicts with CHP • Appropriate
• Wind turbines	N	• Location, noise and vibration issues
• Biomass single room heaters/stoves • Biomass boilers • Biomass community heating scheme	N	• Additional deliveries and storage Issues • Higher running costs • No established supply chain in the area • Management of Bi-products
• Biomass CHP • Natural gas CHP • Sewerage gas and other biogases CHP	N	• Conflicts with gas CHP • Additional deliveries and storage issues • Higher running costs • No established supply chain in the area
• Ground source heat pumps • Water source heat pumps • Air source heat pumps	N N N Y	• No open land for horizontal piping • Unknown ground conditions • No water source in close proximity to the site plus license restrictions and associated risks • Highly efficient ASHP has been considered to provide heating & Domestic hot water to the whole building, while comfort cooling only to commercial spaces.
• Fuel cells using hydrogen generated from any of the above 'renewable' sources	N	• No source of hydrogen • The required size is not commercially available • Higher capital costs compare to CHP

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^2 at the optimum (south facing) angle of 30^o 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.

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 Generated	Energy saving	CO2 Savings
	(m^2)	(kWh/yr)	(kWh/yr)	(tCO_2/yr)
10kWp PV 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 mounted on flat roofs are typically looked upon favorably by local planners and the GLA.
Noise	None
Life cycle cost / lifecycle impact of the potential specification in terms of carbon emissions	PV systems typically result in life-cycle CO_2 savings (typical embodied CO_2 payback is 3-6 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 (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building 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 carbon dioxide savings	
	(Tonnes CO_2 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	-
	(Tonnes CO2)	
Cumulative savings for off-set 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 for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building 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-domestic carbon dioxide savings	
	(Tonnes CO_2 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 (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	5	-
Shortfall	-6	-190
Cash in-lieu contribution (£)	**-11,427**	-

7 Site Wide Savings

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	21		
Be lean	11	10	48%
Be clean	11	0	0%
Be green	4	7	34%
	-	**CO2 savings off-set (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.

Pivotal INTERNATIONAL

8.2 BRUKL & SAP Reports

8.3 PV Array layout

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 1

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	51.7	(1a)	x	2.5	(2a)	=	129.25	(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:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

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												
(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

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			9	x1/[1/(1.4)+ 0.04]		=	11.93			(27)
Windows Type 2			3.92	x1/[1/(1.4)+ 0.04]		=	5.2			(27)
Floor			51.7	x	0.13	=	6.721			(28)
Walls Type1	19.75	9	10.75	x	0.18	=	1.94			(29)
Walls Type2	14.75	3.92	10.83	x	0.18	=	1.95			(29)
Walls Type3	20	0	20	x	0.18	=	3.6			(29)
Total area of elements, m²			106.2							(31)
Party wall			20	x	0	=	0			(32)
Party ceiling			51.7							(32b)
Internal wall **			77							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	31.33	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	11416.3	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.31 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.64 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(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 transfer coefficient, W/K (39)m = (37) + (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	

Average = Sum(39)$_{1...12}$ /12= 61.02 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = Sum(40)$_{1...12}$ /12= 1.18 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.74 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 75.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	83.08	80.06	77.04	74.02	71	67.98	67.98	71	74.02	77.04	80.06	83.08	

Total = Sum(44)$_{1...12}$ = 906.36 (44)

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)

(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	

Total = Sum(45)$_{1...12}$ = 1188.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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	

Output from water heater (annual)$_{1...12}$	1641.44	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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 calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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	87.01	87.01	87.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 5)

(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 gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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 gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (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	x	0.63	x	0.7	=	27.51	(75)

Northeast	0.9x	0.77	x	3.92	x	41.38	x	0.63	x	0.7	=	49.57	(75)
Northeast	0.9x	0.77	x	3.92	x	67.96	x	0.63	x	0.7	=	81.41	(75)
Northeast	0.9x	0.77	x	3.92	x	91.35	x	0.63	x	0.7	=	109.43	(75)
Northeast	0.9x	0.77	x	3.92	x	97.38	x	0.63	x	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	x	0.63	x	0.7	=	87.01	(75)
Northeast	0.9x	0.77	x	3.92	x	50.42	x	0.63	x	0.7	=	60.4	(75)
Northeast	0.9x	0.77	x	3.92	x	28.07	x	0.63	x	0.7	=	33.62	(75)
Northeast	0.9x	0.77	x	3.92	x	14.2	x	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	0.9x	0.77	x	9	x	36.79		0.63	x	0.7	=	101.2	(79)
Southwest	0.9x	0.77	x	9	x	62.67		0.63	x	0.7	=	172.38	(79)
Southwest	0.9x	0.77	x	9	x	85.75		0.63	x	0.7	=	235.86	(79)
Southwest	0.9x	0.77	x	9	x	106.25		0.63	x	0.7	=	292.25	(79)
Southwest	0.9x	0.77	x	9	x	119.01		0.63	x	0.7	=	327.34	(79)
Southwest	0.9x	0.77	x	9	x	118.15		0.63	x	0.7	=	324.97	(79)
Southwest	0.9x	0.77	x	9	x	113.91		0.63	x	0.7	=	313.31	(79)
Southwest	0.9x	0.77	x	9	x	104.39		0.63	x	0.7	=	287.13	(79)
Southwest	0.9x	0.77	x	9	x	92.85		0.63	x	0.7	=	255.39	(79)
Southwest	0.9x	0.77	x	9	x	69.27		0.63	x	0.7	=	190.52	(79)
Southwest	0.9x	0.77	x	9	x	44.07		0.63	x	0.7	=	121.22	(79)
Southwest	0.9x	0.77	x	9	x	31.49		0.63	x	0.7	=	86.61	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	114.72	199.9	285.44	373.66	436.77	441.64	422.45	374.13	315.79	224.15	138.22	97.65	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	401.28	484.26	559.45	631.41	678.29	667.26	637.93	594.97	545.1	469.88	402.76	376.15	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.89	0.75	0.56	0.41	0.46	0.71	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.85	20.06	20.35	20.68	20.89	20.98	21	20.99	20.94	20.64	20.18	19.81	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.92	19.92	19.94	19.94	19.95	19.95	19.95	19.94	19.94	19.93	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.86	0.69	0.48	0.32	0.36	0.62	0.9	0.98	0.99	(89)

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

(90)m=	18.41	18.72	19.13	19.59	19.84	19.94	19.95	19.95	19.9	19.55	18.9	18.36	(90)

fLA = Living area ÷ (4) = | 0.5 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(92)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	(92)

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

(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 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=	0.99	0.98	0.94	0.86	0.71	0.52	0.36	0.41	0.66	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	397.24	472.88	528.39	545.2	484.05	345.93	232.44	243.21	360.14	425.24	394.25	373.29	(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=	920.96	897.48	818.15	685.66	528.03	353.11	233.44	244.96	382.6	578.51	761.27	915.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	389.65	285.33	215.58	101.13	32.73	0	0	0	0	114.03	264.26	403.19	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1805.89 (98)

Space heating requirement in kWh/m²/year 34.93 (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) × [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)													
	389.65	285.33	215.58	101.13	32.73	0	0	0	0	114.03	264.26	403.19	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	417.18	305.5	230.81	108.28	35.04	0	0	0	0	122.09	282.93	431.68	

Total (kWh/year) =Sum(211)1...5,10...12= 1933.5 (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

Total (kWh/year) =Sum(215)1...5,10...12= 0 (215)

Water heating

Output from water heater (calculated above)													
	165.55	144.61	150.46	133.45	129.2	113.79	109.02	121.54	122.88	139.92	149.36	161.66	
Efficiency of water heater												80.3	(216)
(217)m=	87.13	86.73	85.96	84.36	82.16	80.3	80.3	80.3	80.3	84.54	86.47	87.26	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	190	166.74	175.04	158.18	157.27	141.71	135.77	151.35	153.02	165.51	172.73	185.27	

Total = Sum(219a)1...12 = 1952.58 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
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)
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) =		1002.23	(272)
TER =				19.39	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.4.23

Property Address: Flat 2

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	77.9	(1a)	x	2.5	(2a)	=	194.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.9	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			194.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			9.45	x1/[1/(1.4)+ 0.04]		=	12.53			(27)
Windows Type 2			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Walls Type1	10.05	9.45	0.6	x	0.18	=	0.11			(29)
Walls Type2	14.5	0	14.5	x	0.18	=	2.61			(29)
Walls Type3	5.35	3.15	2.2	x	0.18	=	0.4			(29)
Total area of elements, m²			29.9							(31)
Party wall			32	x	0	=	0			(32)
Party wall			33	x	0	=	0			(32)
Party floor			77.9							(32a)
Party ceiling			77.9							(32b)
Internal wall **			82.5							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.82 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15893.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.64 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 24.46 (37)

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Ventilation heat loss calculated monthly (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 transfer coefficient, 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	

Average = Sum(39)$_{1…12}$ /12= 61.17 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.81	0.8	0.8	0.79	0.78	0.77	0.77	0.77	0.78	0.78	0.79	0.79

Average = Sum(40)$_{1…12}$ /12= 0.79 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.42 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.72 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	100.89	97.22	93.55	89.88	86.21	82.55	82.55	86.21	89.88	93.55	97.22	100.89	

Total = Sum(44)$_{1…12}$ = 1100.62 (44)

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)

(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 = Sum(45)$_{1…12}$ = 1443.08 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.44	19.63	20.25	17.66	16.94	14.62	13.55	15.55	15.73	18.34	20.01	21.73	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	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 required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	200.58	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 input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	200.58	175.6	182.7	162.05	156.89	138.18	132.39	147.58	149.21	169.91	181.37	195.85

Output from water heater (annual)$_{1...12}$ | 1992.33 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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 (calculated in Appendix L, equation L9 or L9a), also see Table 5

(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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 5)

(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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	381.27	378.67	364.71	342.63	320.26	298.69	285.11	291.69	303.37	325.66	351.14	370.22	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(75)
Northeast	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(75)
Northeast	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(75)
Northeast	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(75)
Northeast	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(75)
Northeast	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(75)
Northeast	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(75)
Northeast	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(75)
Northeast	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(75)
Northeast	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(75)
Northeast	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(75)
Northeast	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(75)
Southwest	0.9x	0.77	x	9.45	x	36.79		0.63	x	0.7	=	106.26	(79)
Southwest	0.9x	0.77	x	9.45	x	62.67		0.63	x	0.7	=	181	(79)
Southwest	0.9x	0.77	x	9.45	x	85.75		0.63	x	0.7	=	247.66	(79)
Southwest	0.9x	0.77	x	9.45	x	106.25		0.63	x	0.7	=	306.86	(79)
Southwest	0.9x	0.77	x	9.45	x	119.01		0.63	x	0.7	=	343.71	(79)
Southwest	0.9x	0.77	x	9.45	x	118.15		0.63	x	0.7	=	341.22	(79)
Southwest	0.9x	0.77	x	9.45	x	113.91		0.63	x	0.7	=	328.97	(79)
Southwest	0.9x	0.77	x	9.45	x	104.39		0.63	x	0.7	=	301.48	(79)
Southwest	0.9x	0.77	x	9.45	x	92.85		0.63	x	0.7	=	268.16	(79)
Southwest	0.9x	0.77	x	9.45	x	69.27		0.63	x	0.7	=	200.05	(79)
Southwest	0.9x	0.77	x	9.45	x	44.07		0.63	x	0.7	=	127.28	(79)
Southwest	0.9x	0.77	x	9.45	x	31.49		0.63	x	0.7	=	90.94	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	117.12	203.11	287.49	372.28	431.64	434.97	416.68	371.4	316.7	227.07	140.94	99.81	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	498.39	581.78	652.2	714.91	751.9	733.66	701.79	663.09	620.07	552.73	492.09	470.03	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.89	0.72	0.52	0.38	0.41	0.66	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.29	20.45	20.65	20.86	20.97	21	21	21	20.99	20.84	20.53	20.27	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.25	20.25	20.25	20.27	20.27	20.28	20.28	20.28	20.27	20.27	20.26	20.26	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.96	0.86	0.68	0.46	0.31	0.35	0.59	0.9	0.99	1	(89)

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

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(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)

fLA = Living area ÷ (4) = 0.37 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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 adjustment to the mean internal temperature from Table 4e, where appropriate

(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. 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=	0.99	0.98	0.96	0.87	0.69	0.48	0.34	0.37	0.62	0.9	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	495.57	572.72	623.18	619.01	521.08	355.45	236.63	247.89	382.7	499.57	484.77	468.14	(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=	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 heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	348.57	243.71	167.56	60.44	12	0	0	0	0	71.47	220.06	361.69	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1485.49 (98)

Space heating requirement in kWh/m²/year 19.07 (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) × [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)													
	348.57	243.71	167.56	60.44	12	0	0	0	0	71.47	220.06	361.69	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	373.2	260.93	179.4	64.71	12.84	0	0	0	0	76.52	235.61	387.25	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1590.46 (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

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

200.58	175.6	182.7	162.05	156.89	138.18	132.39	147.58	149.21	169.91	181.37	195.85

Efficiency of water heater 80.3 (216)

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(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 x 100 ÷ (217)m

(219)m=	232.07	204.48	215.37	195.68	193.83	172.08	164.87	183.79	185.82	204.59	212.04	226.23

Total = Sum(219a)$_{1...12}$ = 2390.85 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1590.46	
Water heating fuel used			2390.85	
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			352.4	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	343.54	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	516.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =				859.96	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	182.89	(268)
Total CO2, kg/year			sum of (265)…(271) =		1081.78	(272)

TER = 13.89 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 3

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.8	(1a) x	2.5	(2a) =	124.5	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(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	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 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)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)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	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.13	x1/[1/(1.4)+ 0.04]		=	13.43			(27)
Windows Type 2			2.32	x1/[1/(1.4)+ 0.04]		=	3.08			(27)
Walls Type1	19.5	10.13	9.37	x	0.18	=	1.69			(29)
Walls Type2	3.5	2.32	1.18	x	0.18	=	0.21			(29)
Total area of elements, m²			23							(31)
Party wall			51.75	x	0	=	0			(32)
Party floor			49.8							(32a)
Party ceiling			49.8							(32b)
Internal wall **			45.6							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.4 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13281.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.25 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 20.65 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(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	

Average = Sum(39)$_{1…12}$ /12= 43.71 (39)

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Heat loss parameter (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

Average = Sum(40)$_{1…12}$ /12= 0.88 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 74.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = Sum(44)$_{1…12}$ = 890.4 (44)

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)

(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

Total = Sum(45)$_{1…12}$ = 1167.46 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 — 0 (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): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	41.59	36.2	38.57	35.86	35.54	32.93	34.03	35.54	35.86	38.57	38.79	41.59	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.63	142.06	147.81	131.1	126.93	111.79	107.1	119.4	120.71	137.46	146.73	158.81	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	162.63	142.06	147.81	131.1	126.93	111.79	107.1	119.4	120.71	137.46	146.73	158.81	

Output from water heater (annual)$_{1...12}$ 1612.53 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	50.64	44.25	45.96	40.63	39.27	34.45	32.8	36.77	37.18	42.52	45.59	49.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.08	11.62	9.45	7.15	5.35	4.51	4.88	6.34	8.51	10.8	12.61	13.44	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	146.71	148.24	144.4	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)

Water heating gains (Table 5)

(72)m=	68.07	65.85	61.78	56.43	52.78	47.85	44.09	49.42	51.64	57.15	63.32	66.36	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	279.13	276.97	266.89	251.08	235.32	219.86	209.99	215.26	223.48	239.46	257.74	271.31	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	2.32	x	36.79	x	0.63	x	0.7	=	26.09	(77)
Southeast	0.9x	0.77	x	2.32	x	62.67	x	0.63	x	0.7	=	44.44	(77)
Southeast	0.9x	0.77	x	2.32	x	85.75	x	0.63	x	0.7	=	60.8	(77)
Southeast	0.9x	0.77	x	2.32	x	106.25	x	0.63	x	0.7	=	75.33	(77)
Southeast	0.9x	0.77	x	2.32	x	119.01	x	0.63	x	0.7	=	84.38	(77)

Southeast	0.9x	0.77	x	2.32	x	118.15	x	0.63	x	0.7	=	83.77	(77)
Southeast	0.9x	0.77	x	2.32	x	113.91	x	0.63	x	0.7	=	80.76	(77)
Southeast	0.9x	0.77	x	2.32	x	104.39	x	0.63	x	0.7	=	74.02	(77)
Southeast	0.9x	0.77	x	2.32	x	92.85	x	0.63	x	0.7	=	65.83	(77)
Southeast	0.9x	0.77	x	2.32	x	69.27	x	0.63	x	0.7	=	49.11	(77)
Southeast	0.9x	0.77	x	2.32	x	44.07	x	0.63	x	0.7	=	31.25	(77)
Southeast	0.9x	0.77	x	2.32	x	31.49	x	0.63	x	0.7	=	22.33	(77)
Southwest	0.9x	0.77	x	10.13	x	36.79		0.63	x	0.7	=	113.91	(79)
Southwest	0.9x	0.77	x	10.13	x	62.67		0.63	x	0.7	=	194.03	(79)
Southwest	0.9x	0.77	x	10.13	x	85.75		0.63	x	0.7	=	265.48	(79)
Southwest	0.9x	0.77	x	10.13	x	106.25		0.63	x	0.7	=	328.94	(79)
Southwest	0.9x	0.77	x	10.13	x	119.01		0.63	x	0.7	=	368.44	(79)
Southwest	0.9x	0.77	x	10.13	x	118.15		0.63	x	0.7	=	365.78	(79)
Southwest	0.9x	0.77	x	10.13	x	113.91		0.63	x	0.7	=	352.65	(79)
Southwest	0.9x	0.77	x	10.13	x	104.39		0.63	x	0.7	=	323.18	(79)
Southwest	0.9x	0.77	x	10.13	x	92.85		0.63	x	0.7	=	287.46	(79)
Southwest	0.9x	0.77	x	10.13	x	69.27		0.63	x	0.7	=	214.44	(79)
Southwest	0.9x	0.77	x	10.13	x	44.07		0.63	x	0.7	=	136.44	(79)
Southwest	0.9x	0.77	x	10.13	x	31.49		0.63	x	0.7	=	97.48	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	140	238.47	326.28	404.27	452.82	449.55	433.41	397.19	353.29	263.55	167.68	119.81	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.12	515.43	593.17	655.36	688.14	669.41	643.4	612.45	576.77	503.02	425.43	391.12	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.96	0.89	0.76	0.58	0.41	0.29	0.32	0.51	0.81	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.35	20.56	20.78	20.93	20.99	21	21	21	21	20.91	20.61	20.3	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.17	20.18	20.19	20.19	20.2	20.2	20.2	20.19	20.19	20.18	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.95	0.87	0.72	0.53	0.36	0.24	0.27	0.46	0.77	0.96	0.99	(89)

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

(90)m=	19.32	19.62	19.92	20.12	20.18	20.2	20.2	20.2	20.19	20.1	19.7	19.26	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)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	(92)

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

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(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 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 x (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		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													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) × [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		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	222.62	133.46	74.6	20.91	3.62	0	0	0	0	27.47	127.09	238.29		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													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		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													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 x 100 ÷ (217)m														
(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		
Total = Sum(219a)$_{1...12}$ =													1951.76	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		848.06

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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-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
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) + (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		sum of (265)…(271) =		763.57	(272)

TER =	15.33	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 4

Address : 3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	92.6	(1a) x	2.5	(2a) =	231.5	(3a)
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 heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 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			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 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)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.98	x1/[1/(1.4)+ 0.04]		=	14.56			(27)
Windows Type 2			2.7	x1/[1/(1.4)+ 0.04]		=	3.58			(27)
Windows Type 3			2.7	x1/[1/(1.4)+ 0.04]		=	3.58			(27)
Walls Type1	34.5	10.98	23.52	x	0.18	=	4.23			(29)
Walls Type2	12.5	2.7	9.8	x	0.18	=	1.76			(29)
Walls Type3	23.25	2.7	20.55	x	0.18	=	3.7			(29)
Total area of elements, m²			70.25							(31)
Party wall			47	x	0	=	0			(32)
Party floor			92.6							(32a)
Party ceiling			92.6							(32b)
Internal wall **			146.5							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 31.41 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 19835.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.39 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.8 (37)

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Ventilation heat loss calculated monthly (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 transfer coefficient, W/K (39)m = (37) + (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	

Average = Sum(39)1…12 /12= 79.81 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.88	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85	0.86	0.86	0.87	

Average = Sum(40)1…12 /12= 0.86 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.66 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.37 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	107.1	103.21	99.31	95.42	91.52	87.63	87.63	91.52	95.42	99.31	103.21	107.1	

Total = Sum(44)1…12 = 1168.4 (44)

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)

(45)m=	158.83	138.92	143.35	124.97	119.92	103.48	95.89	110.03	111.35	129.76	141.65	153.82	

Total = Sum(45)1…12 = 1531.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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

Output from water heater (annual)$_{1...12}$ | 2105.7 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	65.55	57.7	60.32	53.32	51.53	45.21	43.05	48.25	48.79	55.8	59.43	63.88	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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 (calculated in Appendix L, equation L9 or L9a), also 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 gains (Table 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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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 gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast	0.9x	0.77	x	2.7	x	11.28	x	0.63	x	0.7	=	9.31	(75)
Northeast	0.9x	0.77	x	2.7	x	22.97	x	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	x	0.63	x	0.7	=	56.07	(75)
Northeast	0.9x	0.77	x	2.7	x	91.35	x	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	x	91.1	x	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	x	0.63	x	0.7	=	23.16	(75)
Northeast	0.9x	0.77	x	2.7	x	14.2	x	0.63	x	0.7	=	11.71	(75)
Northeast	0.9x	0.77	x	2.7	x	9.21	x	0.63	x	0.7	=	7.6	(75)
Southeast	0.9x	0.77	x	2.7	x	36.79	x	0.63	x	0.7	=	30.36	(77)
Southeast	0.9x	0.77	x	2.7	x	62.67	x	0.63	x	0.7	=	51.72	(77)
Southeast	0.9x	0.77	x	2.7	x	85.75	x	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	x	113.91	x	0.63	x	0.7	=	93.99	(77)
Southeast	0.9x	0.77	x	2.7	x	104.39	x	0.63	x	0.7	=	86.14	(77)
Southeast	0.9x	0.77	x	2.7	x	92.85	x	0.63	x	0.7	=	76.62	(77)
Southeast	0.9x	0.77	x	2.7	x	69.27	x	0.63	x	0.7	=	57.16	(77)
Southeast	0.9x	0.77	x	2.7	x	44.07	x	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	0.9x	0.77	x	10.98	x	36.79		0.63	x	0.7	=	123.47	(79)
Southwest	0.9x	0.77	x	10.98	x	62.67		0.63	x	0.7	=	210.31	(79)
Southwest	0.9x	0.77	x	10.98	x	85.75		0.63	x	0.7	=	287.75	(79)
Southwest	0.9x	0.77	x	10.98	x	106.25		0.63	x	0.7	=	356.54	(79)
Southwest	0.9x	0.77	x	10.98	x	119.01		0.63	x	0.7	=	399.36	(79)
Southwest	0.9x	0.77	x	10.98	x	118.15		0.63	x	0.7	=	396.47	(79)
Southwest	0.9x	0.77	x	10.98	x	113.91		0.63	x	0.7	=	382.24	(79)
Southwest	0.9x	0.77	x	10.98	x	104.39		0.63	x	0.7	=	350.3	(79)
Southwest	0.9x	0.77	x	10.98	x	92.85		0.63	x	0.7	=	311.58	(79)
Southwest	0.9x	0.77	x	10.98	x	69.27		0.63	x	0.7	=	232.44	(79)
Southwest	0.9x	0.77	x	10.98	x	44.07		0.63	x	0.7	=	147.88	(79)
Southwest	0.9x	0.77	x	10.98	x	31.49		0.63	x	0.7	=	105.66	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(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 gains – internal and solar (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)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(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	20.19	(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 ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(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)

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

(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													
(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=	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 x [(97)m – (95)m] x (41)m													
(98)m=	486.79	343.85	244.14	98.31	23.49	0	0	0	0	114.2	317.45	505.91	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2134.14 (98)

Space heating requirement in kWh/m²/year 23.05 (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) × [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)													
	486.79	343.85	244.14	98.31	23.49	0	0	0	0	114.2	317.45	505.91	
(211)m = {[(98)m x (204)] } x 100 ÷ (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)$_{1...5,10....12}$= 2284.95 (211)

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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

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

209.79	184.94	193.96	172.03	166.56	146.69	140.54	156.67	158.4	180.37	190.96	204.78

Efficiency of water heater 80.3 (216)

(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

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	240.86	213.58	226.5	205.53	204.55	182.68	175.02	195.11	197.26	214.89	221.22	234.73

Total = Sum(219a)$_{1...12}$ = 2511.96 (219)

Annual totals	**kWh/year**	**kWh/year**	
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		(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		393.13	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	493.55	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	542.58	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1036.13	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	204.03	(268)
Total CO2, kg/year		sum of (265)…(271) =		1279.09	(272)

TER = 13.81 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 5

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	76.8	(1a) x	2.5	(2a) =	192	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.8	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *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*		0	(11)
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) ÷ 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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind 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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(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)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)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	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.7	x1/[1/(1.4)+ 0.04]		=	3.58			(27)
Windows Type 2			3.6	x1/[1/(1.4)+ 0.04]		=	4.77			(27)
Windows Type 3			7.2	x1/[1/(1.4)+ 0.04]		=	9.55			(27)
Windows Type 4			4.94	x1/[1/(1.4)+ 0.04]		=	6.55			(27)
Walls Type1	5	2.7	2.3	x	0.18	=	0.41			(29)
Walls Type2	31.5	3.6	27.9	x	0.18	=	5.02			(29)
Walls Type3	22.75	7.2	15.55	x	0.18	=	2.8			(29)
Walls Type4	15	4.94	10.06	x	0.18	=	1.81			(29)
Total area of elements, m²			74.25							(31)
Party wall			37.5	x	0	=	0			(32)
Party floor			76.8							(32a)
Party ceiling			76.8							(32b)
Internal wall **			117							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	34.49	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16870.8	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K	4.78	(36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 39.27 (37)

Ventilation heat loss calculated monthly (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 transfer coefficient, W/K (39)m = (37) + (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	

Average = Sum(39)$_{1\ldots12}$ /12= 76.37 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.01	1.01	0.99	0.99	0.98	0.98	0.97	0.98	0.99	1	1	

Average = Sum(40)$_{1\ldots12}$ /12= 0.99 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.4 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.18 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = Sum(44)$_{1\ldots12}$ = 1094.21 (44)

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)

(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 = Sum(45)$_{1\ldots12}$ = 1434.68 (45)

If instantaneous water heating at point of use (no hot water 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)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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

Output from water heater (annual)$_{1...12}$ 1981.33 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 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)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35	35	35	35	35	35	35	35	35	35	35	35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(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)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (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)
Southwest	0.9x	0.77	x	2.7	x	36.79		0.63	x	0.7	=	30.36	(79)
Southwest	0.9x	0.77	x	2.7	x	62.67		0.63	x	0.7	=	51.72	(79)
Southwest	0.9x	0.77	x	2.7	x	85.75		0.63	x	0.7	=	70.76	(79)
Southwest	0.9x	0.77	x	2.7	x	106.25		0.63	x	0.7	=	87.67	(79)
Southwest	0.9x	0.77	x	2.7	x	119.01		0.63	x	0.7	=	98.2	(79)
Southwest	0.9x	0.77	x	2.7	x	118.15		0.63	x	0.7	=	97.49	(79)
Southwest	0.9x	0.77	x	2.7	x	113.91		0.63	x	0.7	=	93.99	(79)
Southwest	0.9x	0.77	x	2.7	x	104.39		0.63	x	0.7	=	86.14	(79)
Southwest	0.9x	0.77	x	2.7	x	92.85		0.63	x	0.7	=	76.62	(79)
Southwest	0.9x	0.77	x	2.7	x	69.27		0.63	x	0.7	=	57.16	(79)
Southwest	0.9x	0.77	x	2.7	x	44.07		0.63	x	0.7	=	36.37	(79)
Southwest	0.9x	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	x	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	x	0.63	x	0.7	=	139.32	(80)
West	0.9x	0.77	x	4.94	x	113.09	x	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	x	0.63	x	0.7	=	142.93	(80)
West	0.9x	0.77	x	4.94	x	73.59	x	0.63	x	0.7	=	111.1	(80)
West	0.9x	0.77	x	4.94	x	45.59	x	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	0.77	x	4.94	x	16.15	x	0.63	x	0.7	=	24.38	(80)
Northwest	0.9x	0.77	x	7.2	x	11.28	x	0.63	x	0.7	=	24.83	(81)
Northwest	0.9x	0.77	x	7.2	x	22.97	x	0.63	x	0.7	=	50.54	(81)
Northwest	0.9x	0.77	x	7.2	x	41.38	x	0.63	x	0.7	=	91.05	(81)

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Northwest	0.9x	0.77	x	7.2	x	67.96	x	0.63	x	0.7	=	149.53	(81)
Northwest	0.9x	0.77	x	7.2	x	91.35	x	0.63	x	0.7	=	201	(81)
Northwest	0.9x	0.77	x	7.2	x	97.38	x	0.63	x	0.7	=	214.29	(81)
Northwest	0.9x	0.77	x	7.2	x	91.1	x	0.63	x	0.7	=	200.46	(81)
Northwest	0.9x	0.77	x	7.2	x	72.63	x	0.63	x	0.7	=	159.81	(81)
Northwest	0.9x	0.77	x	7.2	x	50.42	x	0.63	x	0.7	=	110.95	(81)
Northwest	0.9x	0.77	x	7.2	x	28.07	x	0.63	x	0.7	=	61.76	(81)
Northwest	0.9x	0.77	x	7.2	x	14.2	x	0.63	x	0.7	=	31.24	(81)
Northwest	0.9x	0.77	x	7.2	x	9.21	x	0.63	x	0.7	=	20.28	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	97.25	185.52	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 solar (84)m = (73)m + (83)m , watts

(84)m=	474.42	560.1	663.73	790.43	887.54	889.49	843.39	757.55	654.34	540.76	467.47	446.99	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.91	0.74	0.53	0.39	0.45	0.74	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.12	20.4	20.74	20.94	20.99	21	21	20.95	20.66	20.25	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.09	20.09	20.1	20.1	20.11	20.1	20.09	20.09	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.88	0.68	0.46	0.31	0.37	0.66	0.94	0.99	1	(89)

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

(90)m=	18.67	18.92	19.32	19.8	20.03	20.1	20.1	20.1	20.06	19.7	19.11	18.65	(90)

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.11	19.33	19.69	20.12	20.34	20.4	20.41	20.41	20.37	20.03	19.5	19.09	(92)

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

(93)m=	19.11	19.33	19.69	20.12	20.34	20.4	20.41	20.41	20.37	20.03	19.5	19.09	(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	0.97	0.88	0.7	0.49	0.34	0.39	0.69	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	472.43	554.22	641.71	696.98	621.82	431.55	285.3	299.01	449.73	509.2	463.08	445.62	(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=	1158.69	1124.9	1024.47	856.79	657.88	435.25	285.68	299.89	472.83	717.61	949.8	1148.25	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	510.57	383.49	284.78	115.06	26.82	0	0	0	0	155.06	350.44	522.76

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2349 (98)

Space heating requirement in kWh/m²/year 30.59 (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) × [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)	510.57	383.49	284.78	115.06	26.82	0	0	0	0	155.06	350.44	522.76	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	546.65	410.59	304.9	123.2	28.72	0	0	0	0	166.02	375.21	559.7	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2514.99 (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

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	199.71	174.58	181.64	161.11	155.98	137.38	131.62	146.72	148.34	168.92	180.32	195.01

Efficiency of water heater 80.3 (216)

(217)m=	87.31	86.98	86.18	84.22	81.64	80.3	80.3	80.3	80.3	84.84	86.7	87.41	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	228.73	200.72	210.77	191.29	191.06	171.08	163.91	182.72	184.74	199.11	207.99	223.09

Total = Sum(219a)$_{1...12}$ = 2355.22 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2514.99	
Water heating fuel used			2355.22	
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			334.76	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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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 = 16.47 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 6

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.7	(1a) x	2.5	(2a) =	129.25	(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:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(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	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.63	x1/[1/(1.4)+ 0.04]		=	14.09			(27)
Windows Type 2			2.3	x1/[1/(1.4)+ 0.04]		=	3.05			(27)
Walls Type1	29	10.63	18.37	x	0.18	=	3.31			(29)
Walls Type2	5	2.3	2.7	x	0.18	=	0.49			(29)
Walls Type3	18	0	18	x	0.18	=	3.24			(29)
Total area of elements, m²			52							(31)
Party wall			44.25	x	0	=	0			(32)
Party floor			51.7							(32a)
Party ceiling			51.7							(32b)
Internal wall **			77							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.17 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14092 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.31 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 29.48 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(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 transfer coefficient, W/K (39)m = (37) + (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	

Average = $Sum(39)_{1...12}$ /12= 53.35 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = $Sum(40)_{1...12}$ /12= 1.03 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.74 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 75.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	83.08	80.06	77.04	74.02	71	67.98	67.98	71	74.02	77.04	80.06	83.08	

Total = $Sum(44)_{1...12}$ = 906.36 (44)

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)

(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	

Total = $Sum(45)_{1...12}$ = 1188.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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

Output from water heater (annual)$_{1...12}$ | 1641.44 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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 calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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	87.01	87.01	87.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 5)

(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 gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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 gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (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	x	0.63	x	0.7	=	16.14	(75)

Northeast	0.9x	0.77	x	2.3	x	41.38	x	0.63	x	0.7	=	29.09	(75)
Northeast	0.9x	0.77	x	2.3	x	67.96	x	0.63	x	0.7	=	47.77	(75)
Northeast	0.9x	0.77	x	2.3	x	91.35	x	0.63	x	0.7	=	64.21	(75)
Northeast	0.9x	0.77	x	2.3	x	97.38	x	0.63	x	0.7	=	68.45	(75)
Northeast	0.9x	0.77	x	2.3	x	91.1	x	0.63	x	0.7	=	64.04	(75)
Northeast	0.9x	0.77	x	2.3	x	72.63	x	0.63	x	0.7	=	51.05	(75)
Northeast	0.9x	0.77	x	2.3	x	50.42	x	0.63	x	0.7	=	35.44	(75)
Northeast	0.9x	0.77	x	2.3	x	28.07	x	0.63	x	0.7	=	19.73	(75)
Northeast	0.9x	0.77	x	2.3	x	14.2	x	0.63	x	0.7	=	9.98	(75)
Northeast	0.9x	0.77	x	2.3	x	9.21	x	0.63	x	0.7	=	6.48	(75)
Southwest	0.9x	0.77	x	10.63	x	36.79		0.63	x	0.7	=	119.53	(79)
Southwest	0.9x	0.77	x	10.63	x	62.67		0.63	x	0.7	=	203.61	(79)
Southwest	0.9x	0.77	x	10.63	x	85.75		0.63	x	0.7	=	278.58	(79)
Southwest	0.9x	0.77	x	10.63	x	106.25		0.63	x	0.7	=	345.18	(79)
Southwest	0.9x	0.77	x	10.63	x	119.01		0.63	x	0.7	=	386.63	(79)
Southwest	0.9x	0.77	x	10.63	x	118.15		0.63	x	0.7	=	383.83	(79)
Southwest	0.9x	0.77	x	10.63	x	113.91		0.63	x	0.7	=	370.05	(79)
Southwest	0.9x	0.77	x	10.63	x	104.39		0.63	x	0.7	=	339.13	(79)
Southwest	0.9x	0.77	x	10.63	x	92.85		0.63	x	0.7	=	301.64	(79)
Southwest	0.9x	0.77	x	10.63	x	69.27		0.63	x	0.7	=	225.03	(79)
Southwest	0.9x	0.77	x	10.63	x	44.07		0.63	x	0.7	=	143.17	(79)
Southwest	0.9x	0.77	x	10.63	x	31.49		0.63	x	0.7	=	102.29	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	127.46	219.75	307.67	392.94	450.83	452.28	434.09	390.18	337.09	244.76	153.15	108.77	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	414.02	504.11	581.68	650.7	692.35	677.9	649.57	611.02	566.39	490.49	417.68	387.28	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.94	0.84	0.68	0.49	0.36	0.39	0.62	0.89	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.08	20.3	20.56	20.82	20.95	20.99	21	21	20.98	20.78	20.38	20.04	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.04	20.04	20.05	20.06	20.06	20.07	20.07	20.07	20.06	20.06	20.05	20.05	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.92	0.81	0.62	0.42	0.28	0.32	0.55	0.86	0.97	0.99	(89)

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

(90)m=	18.84	19.15	19.52	19.86	20.02	20.06	20.07	20.07	20.05	19.83	19.28	18.78	(90)

fLA = Living area ÷ (4) = 0.51 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(92)m=	19.47	19.73	20.05	20.35	20.49	20.53	20.54	20.54	20.52	20.31	19.84	19.42		(92)

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

(93)m=	19.47	19.73	20.05	20.35	20.49	20.53	20.54	20.54	20.52	20.31	19.84	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=	0.99	0.97	0.92	0.82	0.65	0.46	0.32	0.36	0.58	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	408.96	488.25	537.15	532.16	448.92	310.45	207.36	217.31	331.27	425.53	406.09	383.79	(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=	822.57	802.33	731.11	610.76	468.05	312.78	207.62	217.77	339.64	517.18	681.01	817.46	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	307.73	211.06	144.31	56.59	14.24	0	0	0	0	68.19	197.94	322.65	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1322.71 (98)

Space heating requirement in kWh/m²/year 25.58 (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) × [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)													
	307.73	211.06	144.31	56.59	14.24	0	0	0	0	68.19	197.94	322.65	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	329.47	225.97	154.51	60.59	15.24	0	0	0	0	73.01	211.93	345.45	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1416.18 (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

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	165.55	144.61	150.46	133.45	129.2	113.79	109.02	121.54	122.88	139.92	149.36	161.66

Efficiency of water heater 80.3 (216)

(217)m=	86.59	86	84.95	83.06	81.2	80.3	80.3	80.3	80.3	83.35	85.76	86.76	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	191.19	168.15	177.12	160.66	159.11	141.71	135.77	151.35	153.02	167.87	174.16	186.34

Total = Sum(219a)$_{1...12}$ = 1966.45 (219)

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Annual totals		kWh/year	kWh/year	
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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
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) =		893.49	(272)
TER =					17.28	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 7

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	84.7	(1a)	x	2.5	(2a)	=	211.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	84.7	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	211.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.14	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

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												
(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

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(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	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.98	x1/[1/(1.4)+ 0.04]		=	7.93			(27)
Windows Type 2			0.86	x1/[1/(1.4)+ 0.04]		=	1.14			(27)
Windows Type 3			7.4	x1/[1/(1.4)+ 0.04]		=	9.81			(27)
Windows Type 4			4.83	x1/[1/(1.4)+ 0.04]		=	6.4			(27)
Windows Type 5			2.11	x1/[1/(1.4)+ 0.04]		=	2.8			(27)
Walls Type1	27	5.98	21.02	x	0.18	=	3.78			(29)
Walls Type2	32.5	0.86	31.64	x	0.18	=	5.7			(29)
Walls Type3	14.5	7.4	7.1	x	0.18	=	1.28			(29)
Walls Type4	22	2.11	19.89	x	0.18	=	3.58			(29)
Walls Type5	9	4.83	4.17	x	0.18	=	0.75			(29)
Roof	84.7	0	84.7	x	0.13	=	11.01			(30)
Total area of elements, m²			189.7							(31)
Party wall			17.5	x	0	=	0			(32)
Party floor			84.7							(32a)
Internal wall **			126.5							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	54.18	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14800.8	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 8.13 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = — 62.31 (37)

Ventilation heat loss calculated 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 transfer coefficient, W/K — (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Average = $Sum(39)_{1...12}$ /12= — 103.74 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.25	1.25	1.24	1.22	1.22	1.21	1.21	1.2	1.21	1.22	1.23	1.24	

Average = $Sum(40)_{1...12}$ /12= — 1.22 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.55 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 94.67 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = $Sum(44)_{1...12}$ = — 1136.02 (44)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = $Sum(45)_{1...12}$ = — 1489.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (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): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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	

Output from water heater (annual)1…12 | 2052.8 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(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)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 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 (Table 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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	0.86	x	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	x	106.25	x	0.63	x	0.7	=	68.52	(77)
Southeast	0.9x	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	x	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	104.39	x	0.63	x	0.7	=	67.32	(77)
Southeast	0.9x	0.77	x	2.11	x	92.85	x	0.63	x	0.7	=	59.87	(77)
Southeast	0.9x	0.77	x	2.11	x	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)
Southwest	0.9x	0.77	x	5.98	x	36.79		0.63	x	0.7	=	67.24	(79)
Southwest	0.9x	0.77	x	5.98	x	62.67		0.63	x	0.7	=	114.54	(79)
Southwest	0.9x	0.77	x	5.98	x	85.75		0.63	x	0.7	=	156.72	(79)
Southwest	0.9x	0.77	x	5.98	x	106.25		0.63	x	0.7	=	194.18	(79)
Southwest	0.9x	0.77	x	5.98	x	119.01		0.63	x	0.7	=	217.5	(79)
Southwest	0.9x	0.77	x	5.98	x	118.15		0.63	x	0.7	=	215.93	(79)
Southwest	0.9x	0.77	x	5.98	x	113.91		0.63	x	0.7	=	208.18	(79)
Southwest	0.9x	0.77	x	5.98	x	104.39		0.63	x	0.7	=	190.78	(79)
Southwest	0.9x	0.77	x	5.98	x	92.85		0.63	x	0.7	=	169.69	(79)
Southwest	0.9x	0.77	x	5.98	x	69.27		0.63	x	0.7	=	126.59	(79)
Southwest	0.9x	0.77	x	5.98	x	44.07		0.63	x	0.7	=	80.54	(79)
Southwest	0.9x	0.77	x	5.98	x	31.49		0.63	x	0.7	=	57.55	(79)
West	0.9x	0.77	x	4.83	x	19.64	x	0.63	x	0.7	=	28.99	(80)
West	0.9x	0.77	x	4.83	x	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)

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West	0.9x	0.77	x	4.83	x	92.28	x	0.63	x	0.7	=	136.22	(80)
West	0.9x	0.77	x	4.83	x	113.09	x	0.63	x	0.7	=	166.94	(80)
West	0.9x	0.77	x	4.83	x	115.77	x	0.63	x	0.7	=	170.89	(80)
West	0.9x	0.77	x	4.83	x	110.22	x	0.63	x	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	x	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	x	11.28	x	0.63	x	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	x	67.96	x	0.63	x	0.7	=	153.68	(81)
Northwest	0.9x	0.77	x	7.4	x	91.35	x	0.63	x	0.7	=	206.58	(81)
Northwest	0.9x	0.77	x	7.4	x	97.38	x	0.63	x	0.7	=	220.24	(81)
Northwest	0.9x	0.77	x	7.4	x	91.1	x	0.63	x	0.7	=	206.03	(81)
Northwest	0.9x	0.77	x	7.4	x	72.63	x	0.63	x	0.7	=	164.25	(81)
Northwest	0.9x	0.77	x	7.4	x	50.42	x	0.63	x	0.7	=	114.03	(81)
Northwest	0.9x	0.77	x	7.4	x	28.07	x	0.63	x	0.7	=	63.47	(81)
Northwest	0.9x	0.77	x	7.4	x	14.2	x	0.63	x	0.7	=	32.11	(81)
Northwest	0.9x	0.77	x	7.4	x	9.21	x	0.63	x	0.7	=	20.84	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	148.44	269.64	409.87	570.46	691.77	708.84	674.3	581.18	465.47	309.4	180.95	124.95	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	548.17	667.28	793	930.44	1028.18	1022.54	973.66	887.25	783.74	651.04	549.3	512.96	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.92	0.8	0.61	0.46	0.52	0.78	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.67	19.87	20.18	20.57	20.85	20.97	20.99	20.99	20.9	20.51	20.02	19.64	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.88	19.88	19.89	19.9	19.9	19.92	19.92	19.92	19.91	19.9	19.9	19.89	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.9	0.74	0.52	0.35	0.4	0.7	0.94	0.99	1	(89)

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

(90)m=	18.12	18.41	18.86	19.41	19.76	19.9	19.91	19.91	19.83	19.35	18.64	18.08	(90)

fLA = Living area ÷ (4) = 0.3 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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 adjustment to the mean internal temperature from Table 4e, where appropriate

(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. 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=	0.99	0.99	0.96	0.9	0.75	0.55	0.38	0.44	0.72	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(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)
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=	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 requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	720.81	547.95	430.89	211.29	71.52	0	0	0	0	244.85	504.58	737.64	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3469.53 (98)

Space heating requirement in kWh/m²/year 40.96 (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) × [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)													
	720.81	547.95	430.89	211.29	71.52	0	0	0	0	244.85	504.58	737.64	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	771.75	586.67	461.34	226.22	76.57	0	0	0	0	262.16	540.23	789.76	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3714.7 (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

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

205.39	181.09	188.58	167.26	161.94	142.63	136.65	152.33	154.01	175.37	187.04	200.51

Efficiency of water heater 80.3 (216)

(217)m=	87.95	87.66	87.07	85.64	83.15	80.3	80.3	80.3	80.3	85.89	87.43	88.03	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	233.54	206.58	216.59	195.31	194.77	177.62	170.17	189.7	191.8	204.18	213.94	227.77

Total = Sum(219a)$_{1...12}$ = 2421.96 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3714.7	
Water heating fuel used			2421.96	
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			360.52	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
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)
Electricity for pumps, fans and 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 of (265)…(271) =		1551.55	(272)
TER =				18.32	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 8

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.8	(1a) x	2.5	(2a) =	124.5	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(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	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(21)

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

(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 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)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)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	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.13	x1/[1/(1.4)+ 0.04]		=	13.43			(27)
Windows Type 2			2.32	x1/[1/(1.4)+ 0.04]		=	3.08			(27)
Walls Type1	19.5	10.13	9.37	x	0.18	=	1.69			(29)
Walls Type2	3.5	2.32	1.18	x	0.18	=	0.21			(29)
Total area of elements, m²			23							(31)
Party wall			51.75	x	0	=	0			(32)
Party floor			49.8							(32a)
Party ceiling			49.8							(32b)
Internal wall **			45.6							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.4 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13281.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.25 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 20.65 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(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	

Average = Sum(39)$_{1…12}$ /12= 43.71 (39)

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Heat loss parameter (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

Average = $Sum(40)_{1...12}$ /12= 0.88 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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	66.78	69.75	72.72	75.68	78.65	81.62	
										Total = $Sum(44)_{1...12}$ =		890.4	(44)
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)													
(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	
										Total = $Sum(45)_{1...12}$ =		1167.46	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(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 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	41.59	36.2	38.57	35.86	35.54	32.93	34.03	35.54	35.86	38.57	38.79	41.59	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.63	142.06	147.81	131.1	126.93	111.79	107.1	119.4	120.71	137.46	146.73	158.81	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	162.63	142.06	147.81	131.1	126.93	111.79	107.1	119.4	120.71	137.46	146.73	158.81	

Output from water heater (annual)$_{1...12}$ 1612.53 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	50.64	44.25	45.96	40.63	39.27	34.45	32.8	36.77	37.18	42.52	45.59	49.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.08	11.62	9.45	7.15	5.35	4.51	4.88	6.34	8.51	10.8	12.61	13.44	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	146.71	148.24	144.4	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)

Water heating gains (Table 5)

(72)m=	68.07	65.85	61.78	56.43	52.78	47.85	44.09	49.42	51.64	57.15	63.32	66.36	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	279.13	276.97	266.89	251.08	235.32	219.86	209.99	215.26	223.48	239.46	257.74	271.31	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	2.32	x	36.79	x	0.63	x	0.7	=	26.09	(77)
Southeast	0.9x	0.77	x	2.32	x	62.67	x	0.63	x	0.7	=	44.44	(77)
Southeast	0.9x	0.77	x	2.32	x	85.75	x	0.63	x	0.7	=	60.8	(77)
Southeast	0.9x	0.77	x	2.32	x	106.25	x	0.63	x	0.7	=	75.33	(77)
Southeast	0.9x	0.77	x	2.32	x	119.01	x	0.63	x	0.7	=	84.38	(77)

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Southeast	0.9x	0.77	x	2.32	x	118.15	x	0.63	x	0.7	=	83.77	(77)
Southeast	0.9x	0.77	x	2.32	x	113.91	x	0.63	x	0.7	=	80.76	(77)
Southeast	0.9x	0.77	x	2.32	x	104.39	x	0.63	x	0.7	=	74.02	(77)
Southeast	0.9x	0.77	x	2.32	x	92.85	x	0.63	x	0.7	=	65.83	(77)
Southeast	0.9x	0.77	x	2.32	x	69.27	x	0.63	x	0.7	=	49.11	(77)
Southeast	0.9x	0.77	x	2.32	x	44.07	x	0.63	x	0.7	=	31.25	(77)
Southeast	0.9x	0.77	x	2.32	x	31.49	x	0.63	x	0.7	=	22.33	(77)
Southwest	0.9x	0.77	x	10.13	x	36.79		0.63	x	0.7	=	113.91	(79)
Southwest	0.9x	0.77	x	10.13	x	62.67		0.63	x	0.7	=	194.03	(79)
Southwest	0.9x	0.77	x	10.13	x	85.75		0.63	x	0.7	=	265.48	(79)
Southwest	0.9x	0.77	x	10.13	x	106.25		0.63	x	0.7	=	328.94	(79)
Southwest	0.9x	0.77	x	10.13	x	119.01		0.63	x	0.7	=	368.44	(79)
Southwest	0.9x	0.77	x	10.13	x	118.15		0.63	x	0.7	=	365.78	(79)
Southwest	0.9x	0.77	x	10.13	x	113.91		0.63	x	0.7	=	352.65	(79)
Southwest	0.9x	0.77	x	10.13	x	104.39		0.63	x	0.7	=	323.18	(79)
Southwest	0.9x	0.77	x	10.13	x	92.85		0.63	x	0.7	=	287.46	(79)
Southwest	0.9x	0.77	x	10.13	x	69.27		0.63	x	0.7	=	214.44	(79)
Southwest	0.9x	0.77	x	10.13	x	44.07		0.63	x	0.7	=	136.44	(79)
Southwest	0.9x	0.77	x	10.13	x	31.49		0.63	x	0.7	=	97.48	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	140	238.47	326.28	404.27	452.82	449.55	433.41	397.19	353.29	263.55	167.68	119.81	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.12	515.43	593.17	655.36	688.14	669.41	643.4	612.45	576.77	503.02	425.43	391.12	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.96	0.89	0.76	0.58	0.41	0.29	0.32	0.51	0.81	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.35	20.56	20.78	20.93	20.99	21	21	21	21	20.91	20.61	20.3	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.17	20.18	20.19	20.19	20.2	20.2	20.2	20.19	20.19	20.18	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.95	0.87	0.72	0.53	0.36	0.24	0.27	0.46	0.77	0.96	0.99	(89)

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

(90)m=	19.32	19.62	19.92	20.12	20.18	20.2	20.2	20.2	20.19	20.1	19.7	19.26	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)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	(92)

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

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(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 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 x (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	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 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) × [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		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	222.62	133.46	74.6	20.91	3.62	0	0	0	0	27.47	127.09	238.29		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													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		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													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 x 100 ÷ (217)m														
(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		
Total = Sum(219a)$_{1...12}$ =													1951.76	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		848.06

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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-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
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) + (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		sum of (265)…(271) =		763.57	(272)

TER =	15.33	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 1

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.7	(1a) x	2.5	(2a) =	129.25	(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:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *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*		0	(11)
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) ÷ 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) ÷ 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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.08	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.35	x1/[1/(0.73)+ 0.04] =			7.34			(27)
Windows Type 2			4.51	x1/[1/(0.73)+ 0.04] =			3.2			(27)
Floor			51.7	x	0.06	=	3.102			(28)
Walls Type1	19.75	10.35	9.4	x	0.15	=	1.41			(29)
Walls Type2	14.75	4.51	10.24	x	0.15	=	1.54			(29)
Walls Type3	20	0	20	x	0.15	=	3			(29)
Total area of elements, m²			106.2							(31)
Party wall			20	x	0	=	0			(32)
Party ceiling			51.7							(32b)
Internal wall **			77							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.59 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11299.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.55 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(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 transfer coefficient, W/K (39)m = (37) + (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	

Average = $Sum(39)_{1...12}$ /12= 37.25 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = $Sum(40)_{1...12}$ /12= 0.72 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.74 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 75.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	83.08	80.06	77.04	74.02	71	67.98	67.98	71	74.02	77.04	80.06	83.08	

Total = $Sum(44)_{1...12}$ = 906.36 (44)

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)

(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	

Total = $Sum(45)_{1...12}$ = 1188.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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)$_{1...12}$ | 1326.51 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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 calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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	87.01	87.01	87.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 5)

(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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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 gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (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	x	0.63	x	0.1	=	4.52	(75)

Northeast	0.9x	0.77	x	4.51	x	41.38	x	0.63	x	0.1	=	8.15	(75)
Northeast	0.9x	0.77	x	4.51	x	67.96	x	0.63	x	0.1	=	13.38	(75)
Northeast	0.9x	0.77	x	4.51	x	91.35	x	0.63	x	0.1	=	17.99	(75)
Northeast	0.9x	0.77	x	4.51	x	97.38	x	0.63	x	0.1	=	19.18	(75)
Northeast	0.9x	0.77	x	4.51	x	91.1	x	0.63	x	0.1	=	17.94	(75)
Northeast	0.9x	0.77	x	4.51	x	72.63	x	0.63	x	0.1	=	14.3	(75)
Northeast	0.9x	0.77	x	4.51	x	50.42	x	0.63	x	0.1	=	9.93	(75)
Northeast	0.9x	0.77	x	4.51	x	28.07	x	0.63	x	0.1	=	5.53	(75)
Northeast	0.9x	0.77	x	4.51	x	14.2	x	0.63	x	0.1	=	2.8	(75)
Northeast	0.9x	0.77	x	4.51	x	9.21	x	0.63	x	0.1	=	1.81	(75)
Southwest	0.9x	0.77	x	10.35	x	36.79		0.63	x	0.1	=	16.63	(79)
Southwest	0.9x	0.77	x	10.35	x	62.67		0.63	x	0.1	=	28.32	(79)
Southwest	0.9x	0.77	x	10.35	x	85.75		0.63	x	0.1	=	38.75	(79)
Southwest	0.9x	0.77	x	10.35	x	106.25		0.63	x	0.1	=	48.01	(79)
Southwest	0.9x	0.77	x	10.35	x	119.01		0.63	x	0.1	=	53.78	(79)
Southwest	0.9x	0.77	x	10.35	x	118.15		0.63	x	0.1	=	53.39	(79)
Southwest	0.9x	0.77	x	10.35	x	113.91		0.63	x	0.1	=	51.47	(79)
Southwest	0.9x	0.77	x	10.35	x	104.39		0.63	x	0.1	=	47.17	(79)
Southwest	0.9x	0.77	x	10.35	x	92.85		0.63	x	0.1	=	41.96	(79)
Southwest	0.9x	0.77	x	10.35	x	69.27		0.63	x	0.1	=	31.3	(79)
Southwest	0.9x	0.77	x	10.35	x	44.07		0.63	x	0.1	=	19.91	(79)
Southwest	0.9x	0.77	x	10.35	x	31.49		0.63	x	0.1	=	14.23	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)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 – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	299.86	311.64	315.08	313	306.99	292.11	278.94	276.37	275.52	277.21	282.03	289.13	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	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 internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.34	20.41	20.54	20.71	20.88	20.98	21	21	20.96	20.77	20.53	20.33	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.31	20.31	20.31	20.32	20.32	20.33	20.33	20.33	20.33	20.32	20.32	20.32	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.7	0.49	0.52	0.79	0.96	0.99	1	(89)

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

(90)m=	19.42	19.53	19.71	19.97	20.2	20.32	20.33	20.33	20.29	20.05	19.7	19.4	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

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

(92)m=	19.89	19.97	20.13	20.34	20.54	20.65	20.67	20.67	20.63	20.41	20.12	19.87	(92)
(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)

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	0.99	0.97	0.9	0.72	0.51	0.54	0.8	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	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)
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=	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)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	213.09	171.03	146.58	84.74	34.19	0	0	0	0	68.78	144.77	218.98	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1082.17 (98)

Space heating requirement in kWh/m²/year 20.93 (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) × [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)													
	213.09	171.03	146.58	84.74	34.19	0	0	0	0	68.78	144.77	218.98	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	237.03	190.25	163.05	94.26	38.03	0	0	0	0	76.5	161.04	243.58	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 1203.75 (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

Total (kWh/year) =$Sum(215)_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	134.98	118.38	122.94	108.29	104.74	91.59	86.07	97.06	97.71	112.39	121.25	131.09	
Efficiency of water heater												86.7	(216)
(217)m=	88.63	88.56	88.41	88.08	87.47	86.7	86.7	86.7	86.7	87.89	88.41	88.67	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	152.29	133.67	139.06	122.96	119.75	105.64	99.28	111.95	112.7	127.88	137.14	147.83	

Total = $Sum(219a)_{1...12}$ = 1510.16 (219)

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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 positive 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 (230a)…(230g) =		196.42	(231)
Electricity for lighting			322.17	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
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)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	101.94	(267)
Electricity for lighting	(232) x	0.519	=	167.21	(268)
Total CO2, kg/year		sum of (265)…(271) =		855.35	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.54	(273)
EI rating (section 14)				88	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 2

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	77.9	(1a) x	2.5	(2a) =	194.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.9	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		194.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	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 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 x (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) ÷ 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				
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.08	(21)

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												
(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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			9.45	x1/[1/(0.73)+ 0.04] =	6.7			(27)
Windows Type 2			3.15	x1/[1/(0.73)+ 0.04] =	2.23			(27)
Walls Type1	10.05	9.45	0.6	x 0.15 =	0.09			(29)
Walls Type2	14.5	0	14.5	x 0.15 =	2.18			(29)
Walls Type3	5.35	3.15	2.2	x 0.15 =	0.33			(29)
Total area of elements, m²			29.9					(31)
Party wall			32	x 0 =	0			(32)
Party wall			33	x 0 =	0			(32)
Party floor			77.9					(32a)
Party ceiling			77.9					(32b)
Internal wall **			82.5					(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	11.53	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	15893.1	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		6.02	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	17.55	(37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (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 transfer coefficient, 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	

Average = Sum(39)$_{1…12}$ /12= 32.17 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = Sum(40)$_{1…12}$ /12= 0.41 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.42 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.72 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	100.89	97.22	93.55	89.88	86.21	82.55	82.55	86.21	89.88	93.55	97.22	100.89	

Total = Sum(44)$_{1…12}$ = 1100.62 (44)

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)

(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 = Sum(45)$_{1…12}$ = 1443.08 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.44	19.63	20.25	17.66	16.94	14.62	13.55	15.55	15.73	18.34	20.01	21.73	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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

Output from water heater (annual)$_{1...12}$ | 1581.85 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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 (calculated in Appendix L, equation L9 or L9a), also 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 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 + (68)m + (69)m + (70)m + (71)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 gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.1	=	1.55	(75)
Northeast	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.1	=	3.16	(75)
Northeast	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.1	=	5.69	(75)
Northeast	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.1	=	9.35	(75)
Northeast	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.1	=	12.56	(75)
Northeast	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.1	=	13.39	(75)
Northeast	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.1	=	12.53	(75)
Northeast	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.1	=	9.99	(75)
Northeast	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.1	=	6.93	(75)
Northeast	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.1	=	3.86	(75)
Northeast	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.1	=	1.95	(75)
Northeast	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.1	=	1.27	(75)
Southwest	0.9x	0.77	x	9.45	x	36.79		0.63	x	0.1	=	15.18	(79)
Southwest	0.9x	0.77	x	9.45	x	62.67		0.63	x	0.1	=	25.86	(79)
Southwest	0.9x	0.77	x	9.45	x	85.75		0.63	x	0.1	=	35.38	(79)
Southwest	0.9x	0.77	x	9.45	x	106.25		0.63	x	0.1	=	43.84	(79)
Southwest	0.9x	0.77	x	9.45	x	119.01		0.63	x	0.1	=	49.1	(79)
Southwest	0.9x	0.77	x	9.45	x	118.15		0.63	x	0.1	=	48.75	(79)
Southwest	0.9x	0.77	x	9.45	x	113.91		0.63	x	0.1	=	47	(79)
Southwest	0.9x	0.77	x	9.45	x	104.39		0.63	x	0.1	=	43.07	(79)
Southwest	0.9x	0.77	x	9.45	x	92.85		0.63	x	0.1	=	38.31	(79)
Southwest	0.9x	0.77	x	9.45	x	69.27		0.63	x	0.1	=	28.58	(79)
Southwest	0.9x	0.77	x	9.45	x	44.07		0.63	x	0.1	=	18.18	(79)
Southwest	0.9x	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)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=	391.91	401.28	398.82	388.24	373.99	353.07	337.07	337.36	341.76	351.86	365.4	378.58	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.79	0.57	0.41	0.43	0.64	0.9	0.98	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.77	20.81	20.88	20.96	20.99	21	21	21	21	20.98	20.87	20.76	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.59	20.59	20.59	20.6	20.6	20.61	20.61	20.61	20.61	20.6	20.6	20.6	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.76	0.53	0.37	0.39	0.6	0.87	0.98	1	(89)

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

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(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)

fLA = Living area ÷ (4) = 0.37 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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)

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

(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)

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=	0.99	0.99	0.97	0.91	0.76	0.53	0.37	0.39	0.6	0.87	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)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)
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=	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 heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	105.64	77.03	53.33	16.51	1.88	0	0	0	0	9.38	53.78	110.67	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 428.21 (98)

Space heating requirement in kWh/m²/year 5.5 (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) × [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)													
	105.64	77.03	53.33	16.51	1.88	0	0	0	0	9.38	53.78	110.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	117.51	85.68	59.32	18.36	2.09	0	0	0	0	10.44	59.82	123.11	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 476.32 (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

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

161.46	141.54	146.84	129.12	124.72	108.84	102.05	115.4	116.27	134.02	144.87	156.73

Efficiency of water heater 86.7 (216)

(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	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(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	

Total = Sum(219a)$_{1...12}$ =		1812.92	(219)
Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		476.32	
Water heating fuel used		1812.92	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	182.95		(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) =		257.95	(231)
Electricity for lighting		476.95	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	102.88	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	391.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =				494.48	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	133.88	(267)
Electricity for lighting	(232)	x	0.519	=	247.54	(268)
Total CO2, kg/year			sum of (265)…(271) =		875.89	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		11.24	(273)
EI rating (section 14)					90	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 3

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.8	(1a) x	2.5	(2a) =	124.5	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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			
Number of sides sheltered		3	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed 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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) 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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.8	x	1/[1/(0.73)+ 0.04]	=	7.66			(27)
Windows Type 2			2.475	x	1/[1/(0.73)+ 0.04]	=	1.76			(27)
Walls Type1	19.5	10.8	8.7	x	0.15	=	1.31			(29)
Walls Type2	3.5	2.47	1.03	x	0.15	=	0.15			(29)
Total area of elements, m²			23							(31)
Party wall			51.75	x	0	=	0			(32)
Party floor			49.8							(32a)
Party ceiling			49.8							(32b)
Internal wall **			45.6							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 10.87 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13269.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.22 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 16.09 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	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 transfer coefficient, 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	

Average = Sum(39)$_{1…12}$ /12= 25.1 (39)

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Heat loss parameter (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

Average = Sum(40)$_{1...12}$ /12= 0.5 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = Sum(44)$_{1...12}$ = 890.4 (44)

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)

(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

Total = Sum(45)$_{1...12}$ = 1167.46 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(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	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	11.76	10.62	11.74	11.35	11.71	11.32	11.69	11.7	11.33	11.73	11.37	11.76	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	132.8	116.48	120.98	106.58	103.1	90.18	84.76	95.56	96.19	110.62	119.31	128.98	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	132.8	116.48	120.98	106.58	103.1	90.18	84.76	95.56	96.19	110.62	119.31	128.98

Output from water heater (annual)$_{1...12}$ 1305.54 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	43.19	37.85	39.26	34.5	33.31	29.05	27.22	30.81	31.05	35.81	38.73	41.92	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	146.71	148.24	144.4	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)

Water heating gains (Table 5)

(72)m=	58.05	56.33	52.77	47.92	44.78	40.35	36.58	41.41	43.12	48.14	53.8	56.34	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	273.8	271.62	261.27	245.14	229.23	213.98	204.24	209.52	218.02	234.32	252.75	266.11	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	2.47	x	36.79	x	0.63	x	0.1	=	3.98	(77)
Southeast	0.9x	0.77	x	2.47	x	62.67	x	0.63	x	0.1	=	6.77	(77)
Southeast	0.9x	0.77	x	2.47	x	85.75	x	0.63	x	0.1	=	9.27	(77)
Southeast	0.9x	0.77	x	2.47	x	106.25	x	0.63	x	0.1	=	11.48	(77)
Southeast	0.9x	0.77	x	2.47	x	119.01	x	0.63	x	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	113.91	x	0.63	x	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	x	92.85	x	0.63	x	0.1	=	10.03	(77)
Southeast 0.9x	0.77	x	2.47	x	69.27	x	0.63	x	0.1	=	7.48	(77)
Southeast 0.9x	0.77	x	2.47	x	44.07	x	0.63	x	0.1	=	4.76	(77)
Southeast 0.9x	0.77	x	2.47	x	31.49	x	0.63	x	0.1	=	3.4	(77)
Southwest 0.9x	0.77	x	10.8	x	36.79		0.63	x	0.1	=	17.35	(79)
Southwest 0.9x	0.77	x	10.8	x	62.67		0.63	x	0.1	=	29.55	(79)
Southwest 0.9x	0.77	x	10.8	x	85.75		0.63	x	0.1	=	40.43	(79)
Southwest 0.9x	0.77	x	10.8	x	106.25		0.63	x	0.1	=	50.1	(79)
Southwest 0.9x	0.77	x	10.8	x	119.01		0.63	x	0.1	=	56.12	(79)
Southwest 0.9x	0.77	x	10.8	x	118.15		0.63	x	0.1	=	55.71	(79)
Southwest 0.9x	0.77	x	10.8	x	113.91		0.63	x	0.1	=	53.71	(79)
Southwest 0.9x	0.77	x	10.8	x	104.39		0.63	x	0.1	=	49.22	(79)
Southwest 0.9x	0.77	x	10.8	x	92.85		0.63	x	0.1	=	43.78	(79)
Southwest 0.9x	0.77	x	10.8	x	69.27		0.63	x	0.1	=	32.66	(79)
Southwest 0.9x	0.77	x	10.8	x	44.07		0.63	x	0.1	=	20.78	(79)
Southwest 0.9x	0.77	x	10.8	x	31.49		0.63	x	0.1	=	14.85	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(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=	295.12	307.94	310.97	306.72	298.2	282.45	270.25	270.02	271.84	274.47	278.29	284.36	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.91	0.77	0.56	0.4	0.42	0.63	0.88	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.71	20.77	20.85	20.94	20.99	21	21	21	21	20.96	20.83	20.69	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.51	20.51	20.51	20.52	20.52	20.53	20.53	20.53	20.52	20.52	20.52	20.51	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.89	0.73	0.52	0.36	0.38	0.58	0.86	0.97	0.99	(89)

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

(90)m=	20.12	20.2	20.32	20.45	20.51	20.53	20.53	20.53	20.52	20.48	20.3	20.1	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.4	20.47	20.57	20.68	20.73	20.75	20.75	20.75	20.75	20.71	20.55	20.38	(92)

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

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(93)m=	20.25	20.32	20.42	20.53	20.58	20.6	20.6	20.6	20.6	20.56	20.4	20.23	(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=	0.99	0.98	0.96	0.89	0.74	0.52	0.36	0.38	0.59	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)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 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=	409.43	394.66	355.23	292.22	222.47	147.78	98.51	103.12	161.08	249.27	335.19	406.46	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	87.45	62.34	42.78	14.54	2.19	0	0	0	0	9.65	46.85	92.6	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 358.4 (98)

Space heating requirement in kWh/m²/year 7.2 (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) × [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)														
	87.45	62.34	42.78	14.54	2.19	0	0	0	0	9.65	46.85	92.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	97.27	69.34	47.59	16.17	2.44	0	0	0	0	10.73	52.12	103		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													398.67	(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		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	132.8	116.48	120.98	106.58	103.1	90.18	84.76	95.56	96.19	110.62	119.31	128.98		
Efficiency of water heater													86.7	(216)
(217)m=	87.94	87.79	87.51	87.07	86.76	86.7	86.7	86.7	86.7	86.95	87.58	88.01		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	151.01	132.68	138.24	122.41	118.82	104.01	97.76	110.21	110.94	127.22	136.24	146.55		
Total = Sum(219a)$_{1...12}$ =													1496.11	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		398.67

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Water heating fuel used		1496.11	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
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) + (263) + (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) =		671.81	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.49	(273)
EI rating (section 14)				91	(274)

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 4

Address : 3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	92.6	(1a) x	2.5	(2a) =	231.5	(3a)
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 heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *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*		0	(11)
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) ÷ 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) ÷ 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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.08	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.98	x	1/[1/(0.73)+ 0.04]	=	7.79			(27)
Windows Type 2			2.7	x	1/[1/(0.73)+ 0.04]	=	1.92			(27)
Windows Type 3			2.7	x	1/[1/(0.73)+ 0.04]	=	1.92			(27)
Walls Type1	34.5	10.98	23.52	x	0.15	=	3.53			(29)
Walls Type2	12.5	2.7	9.8	x	0.15	=	1.47			(29)
Walls Type3	23.25	2.7	20.55	x	0.15	=	3.08			(29)
Total area of elements, m²			70.25							(31)
Party wall			47	x	0	=	0			(32)
Party floor			92.6							(32a)
Party ceiling			92.6							(32b)
Internal wall **			146.5							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	19.7	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	19835.1	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		7.32	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	27.02	(37)

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Ventilation heat loss calculated monthly (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 transfer coefficient, 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	

Average = Sum(39)$_{1...12}$ /12= 44.4 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = Sum(40)$_{1...12}$ /12= 0.48 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.66 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.37 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	107.1	103.21	99.31	95.42	91.52	87.63	87.63	91.52	95.42	99.31	103.21	107.1	

Total = Sum(44)$_{1...12}$ = 1168.4 (44)

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)

(45)m=	158.83	138.92	143.35	124.97	119.92	103.48	95.89	110.03	111.35	129.76	141.65	153.82	

Total = Sum(45)$_{1...12}$ = 1531.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 required for water heating calculated for each 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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)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

Output from water heater (annual)$_{1...12}$ | 1670.94 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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 (calculated in Appendix L, equation L9 or L9a), also see Table 5

(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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 gains (Table 5)

(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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(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 gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast	0.9x	0.77	x	2.7	x	11.28	x	0.63	x	0.1	=	1.33	(75)
Northeast	0.9x	0.77	x	2.7	x	22.97	x	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	x	0.63	x	0.1	=	8.01	(75)
Northeast	0.9x	0.77	x	2.7	x	91.35	x	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	x	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	x	0.63	x	0.1	=	7.39	(77)
Southeast	0.9x	0.77	x	2.7	x	85.75	x	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	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	x	0.63	x	0.1	=	13.43	(77)
Southeast	0.9x	0.77	x	2.7	x	104.39	x	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	x	69.27	x	0.63	x	0.1	=	8.17	(77)
Southeast	0.9x	0.77	x	2.7	x	44.07	x	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	0.9x	0.77	x	10.98	x	36.79		0.63	x	0.1	=	17.64	(79)
Southwest	0.9x	0.77	x	10.98	x	62.67		0.63	x	0.1	=	30.04	(79)
Southwest	0.9x	0.77	x	10.98	x	85.75		0.63	x	0.1	=	41.11	(79)
Southwest	0.9x	0.77	x	10.98	x	106.25		0.63	x	0.1	=	50.93	(79)
Southwest	0.9x	0.77	x	10.98	x	119.01		0.63	x	0.1	=	57.05	(79)
Southwest	0.9x	0.77	x	10.98	x	118.15		0.63	x	0.1	=	56.64	(79)
Southwest	0.9x	0.77	x	10.98	x	113.91		0.63	x	0.1	=	54.61	(79)
Southwest	0.9x	0.77	x	10.98	x	104.39		0.63	x	0.1	=	50.04	(79)
Southwest	0.9x	0.77	x	10.98	x	92.85		0.63	x	0.1	=	44.51	(79)
Southwest	0.9x	0.77	x	10.98	x	69.27		0.63	x	0.1	=	33.21	(79)
Southwest	0.9x	0.77	x	10.98	x	44.07		0.63	x	0.1	=	21.13	(79)
Southwest	0.9x	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=	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)

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)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(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)

(90)m=	20.02	20.09	20.22	20.39	20.51	20.55	20.55	20.55	20.54	20.44	20.21	20.01	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(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

(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-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	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	16.6	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=	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 x [(97)m – (95)m] x (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)$_{1...5,9...12}$ = 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) × [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)													
	209.67	162.7	130.17	61.14	14.74	0	0	0	0	43.51	129.46	216.39	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	233.23	180.98	144.8	68.01	16.39	0	0	0	0	48.4	144.01	240.7	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1076.52 (211)

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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

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

170.69	149.62	155.18	136.39	131.7	114.86	107.63	121.8	122.75	141.57	153.1	165.67

Efficiency of water heater 86.7 (216)

(217)m=	88.44	88.34	88.13	87.67	87.01	86.7	86.7	86.7	86.7	87.43	88.14	88.48	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	193.01	169.37	176.08	155.58	151.35	132.47	124.14	140.48	141.58	161.92	173.71	187.23

Total = Sum(219a)$_{1...12}$ = 1906.93 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1076.52	
Water heating fuel used			1906.93	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		194.17		(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) =		269.17	(231)
Electricity for lighting			537.95	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	232.53	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	411.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			644.42	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	139.7	(267)
Electricity for lighting	(232) x	0.519	=	279.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1063.32	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.48	(273)
EI rating (section 14)				90	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 5

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	76.8	(1a) x	2.5	(2a) =	192	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.09	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.7	x	1/[1/(0.73)+ 0.04]	=	1.92			(27)
Windows Type 2			3.6	x	1/[1/(0.73)+ 0.04]	=	2.55			(27)
Windows Type 3			7.2	x	1/[1/(0.73)+ 0.04]	=	5.11			(27)
Windows Type 4			4.94	x	1/[1/(0.73)+ 0.04]	=	3.5			(27)
Walls Type1	5	2.7	2.3	x	0.15	=	0.35			(29)
Walls Type2	31.5	3.6	27.9	x	0.15	=	4.19			(29)
Walls Type3	22.75	7.2	15.55	x	0.15	=	2.33			(29)
Walls Type4	15	4.94	10.06	x	0.15	=	1.51			(29)
Total area of elements, m²			74.25							(31)
Party wall			37.5	x	0	=	0			(32)
Party floor			76.8							(32a)
Party ceiling			76.8							(32b)
Internal wall **			117							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	21.45	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16870.8	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K	7.99	(36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 29.44 (37)

Ventilation heat loss calculated monthly (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 transfer coefficient, 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)$_{1\ldots12}$ /12= 44.38 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = Sum(40)$_{1\ldots12}$ /12= 0.58 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.4 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.18 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = Sum(44)$_{1\ldots12}$ = 1094.21 (44)

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)

(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 = Sum(45)$_{1\ldots12}$ = 1434.68 (45)

If instantaneous water heating at point of use (no hot water 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)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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	

Output from water heater (annual)$_{1…12}$ 1573.43 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	25.99	23.09	18.78	14.21	10.63	8.97	9.69	12.6	16.91	21.47	25.06	26.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 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)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35	35	35	35	35	35	35	35	35	35	35	35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 5)

(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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(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)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (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	0.9x	0.77	x	2.7	x	36.79		0.63	x	0.1	=	4.34	(79)
Southwest	0.9x	0.77	x	2.7	x	62.67		0.63	x	0.1	=	7.39	(79)
Southwest	0.9x	0.77	x	2.7	x	85.75		0.63	x	0.1	=	10.11	(79)
Southwest	0.9x	0.77	x	2.7	x	106.25		0.63	x	0.1	=	12.52	(79)
Southwest	0.9x	0.77	x	2.7	x	119.01		0.63	x	0.1	=	14.03	(79)
Southwest	0.9x	0.77	x	2.7	x	118.15		0.63	x	0.1	=	13.93	(79)
Southwest	0.9x	0.77	x	2.7	x	113.91		0.63	x	0.1	=	13.43	(79)
Southwest	0.9x	0.77	x	2.7	x	104.39		0.63	x	0.1	=	12.31	(79)
Southwest	0.9x	0.77	x	2.7	x	92.85		0.63	x	0.1	=	10.95	(79)
Southwest	0.9x	0.77	x	2.7	x	69.27		0.63	x	0.1	=	8.17	(79)
Southwest	0.9x	0.77	x	2.7	x	44.07		0.63	x	0.1	=	5.2	(79)
Southwest	0.9x	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	67.96	x	0.63	x	0.1	=	21.36	(81)
Northwest	0.9x	0.77	x	7.2	x	91.35	x	0.63	x	0.1	=	28.71	(81)
Northwest	0.9x	0.77	x	7.2	x	97.38	x	0.63	x	0.1	=	30.61	(81)
Northwest	0.9x	0.77	x	7.2	x	91.1	x	0.63	x	0.1	=	28.64	(81)
Northwest	0.9x	0.77	x	7.2	x	72.63	x	0.63	x	0.1	=	22.83	(81)
Northwest	0.9x	0.77	x	7.2	x	50.42	x	0.63	x	0.1	=	15.85	(81)
Northwest	0.9x	0.77	x	7.2	x	28.07	x	0.63	x	0.1	=	8.82	(81)
Northwest	0.9x	0.77	x	7.2	x	14.2	x	0.63	x	0.1	=	4.46	(81)
Northwest	0.9x	0.77	x	7.2	x	9.21	x	0.63	x	0.1	=	2.9	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	13.89	26.5	43.27	64.47	81.49	84.81	80.15	66.97	50.59	31.23	17.17	11.54	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	384.95	394.75	397.26	396.11	390.74	372.92	354.98	348.42	344.02	347.22	358.65	371.84	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.92	0.73	0.54	0.57	0.83	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.49	20.54	20.65	20.8	20.93	20.99	21	21	20.98	20.84	20.64	20.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.44	20.44	20.44	20.45	20.45	20.46	20.46	20.46	20.46	20.45	20.45	20.44	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.9	0.68	0.47	0.51	0.78	0.97	1	1	(89)

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

(90)m=	19.74	19.82	19.97	20.2	20.38	20.45	20.46	20.46	20.44	20.25	19.97	19.73	(90)

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20	20.07	20.2	20.4	20.57	20.64	20.64	20.65	20.62	20.45	20.2	19.99	(92)

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

(93)m=	19.85	19.92	20.05	20.25	20.42	20.49	20.49	20.5	20.47	20.3	20.05	19.84	(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	1	0.99	0.97	0.89	0.68	0.48	0.51	0.79	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	384.13	393.4	394.21	385.5	349.53	253.73	169.44	177.52	270.38	336.17	356.74	371.23	(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=	706.48	680.2	611.88	504.2	385.84	256.37	169.55	177.69	279.34	429.51	577.14	701.36	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	239.83	192.73	161.95	85.47	27.01	0	0	0	0	69.44	158.69	245.62		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													1180.74	(98)

Space heating requirement in kWh/m²/year	15.37	(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) × [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)	239.83	192.73	161.95	85.47	27.01	0	0	0	0	69.44	158.69	245.62		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	266.78	214.38	180.15	95.07	30.05	0	0	0	0	77.25	176.52	273.21		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1313.39	(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		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	160.59	140.77	146.05	128.44	124.06	108.27	101.53	114.79	115.66	133.31	144.09	155.88		
Efficiency of water heater													86.7	(216)
(217)m=	88.59	88.52	88.35	87.95	87.26	86.7	86.7	86.7	86.7	87.77	88.35	88.63		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	181.27	159.03	165.3	146.03	142.18	124.88	117.1	132.4	133.4	151.89	163.09	175.88		
Total = Sum(219a)$_{1...12}$ =													1792.45	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1313.39	
Water heating fuel used			1792.45	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		173.81		(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) =		248.81	(231)
Electricity for lighting			459.05	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions 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 of (265)…(271) =		1038.24	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		13.52	(273)
EI rating (section 14)					89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 6

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.7	(1a) x	2.5	(2a) =	129.25	(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:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	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 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 x (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) ÷ 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				
Number of sides sheltered			3	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) 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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			13.5	x	1/[1/(0.73)+ 0.04]	=	9.58			(27)
Windows Type 2			2.925	x	1/[1/(0.73)+ 0.04]	=	2.07			(27)
Walls Type1	29	13.5	15.5	x	0.15	=	2.33			(29)
Walls Type2	5	2.92	2.08	x	0.15	=	0.31			(29)
Walls Type3	18	0	18	x	0.15	=	2.7			(29)
Total area of elements, m²			52							(31)
Party wall			44.25	x	0	=	0			(32)
Party floor			51.7							(32a)
Party ceiling			51.7							(32b)
Internal wall **			77							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	16.99	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13882.3	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		7.96	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	24.95	(37)

Ventilation heat loss calculated monthly (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 transfer coefficient, W/K (39)m = (37) + (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	

Average = Sum(39)$_{1...12}$ /12= 34.3 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.68	0.67	0.67	0.66	0.66	0.65	0.65	0.65	0.66	0.66	0.67	0.67

Average = Sum(40)$_{1...12}$ /12= 0.66 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.74 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 75.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	83.08	80.06	77.04	74.02	71	67.98	67.98	71	74.02	77.04	80.06	83.08

Total = Sum(44)$_{1...12}$ = 906.36 (44)

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)

(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

Total = Sum(45)$_{1...12}$ = 1188.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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)$_{1...12}$ | 1326.51 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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 calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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	87.01	87.01	87.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 5)

(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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	280.83	278.63	268.05	251.5	235.15	219.48	209.46	214.81	223.52	240.23	259.15	272.9	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	2.92	x	11.28	x	0.63	x	0.1	=	1.44	(75)
Northeast 0.9x	0.77	x	2.92	x	22.97	x	0.63	x	0.1	=	2.93	(75)

Northeast	0.9x	0.77	x	2.92	x	41.38	x	0.63	x	0.1	=	5.28	(75)
Northeast	0.9x	0.77	x	2.92	x	67.96	x	0.63	x	0.1	=	8.68	(75)
Northeast	0.9x	0.77	x	2.92	x	91.35	x	0.63	x	0.1	=	11.67	(75)
Northeast	0.9x	0.77	x	2.92	x	97.38	x	0.63	x	0.1	=	12.44	(75)
Northeast	0.9x	0.77	x	2.92	x	91.1	x	0.63	x	0.1	=	11.63	(75)
Northeast	0.9x	0.77	x	2.92	x	72.63	x	0.63	x	0.1	=	9.27	(75)
Northeast	0.9x	0.77	x	2.92	x	50.42	x	0.63	x	0.1	=	6.44	(75)
Northeast	0.9x	0.77	x	2.92	x	28.07	x	0.63	x	0.1	=	3.58	(75)
Northeast	0.9x	0.77	x	2.92	x	14.2	x	0.63	x	0.1	=	1.81	(75)
Northeast	0.9x	0.77	x	2.92	x	9.21	x	0.63	x	0.1	=	1.18	(75)
Southwest	0.9x	0.77	x	13.5	x	36.79		0.63	x	0.1	=	21.69	(79)
Southwest	0.9x	0.77	x	13.5	x	62.67		0.63	x	0.1	=	36.94	(79)
Southwest	0.9x	0.77	x	13.5	x	85.75		0.63	x	0.1	=	50.54	(79)
Southwest	0.9x	0.77	x	13.5	x	106.25		0.63	x	0.1	=	62.62	(79)
Southwest	0.9x	0.77	x	13.5	x	119.01		0.63	x	0.1	=	70.14	(79)
Southwest	0.9x	0.77	x	13.5	x	118.15		0.63	x	0.1	=	69.64	(79)
Southwest	0.9x	0.77	x	13.5	x	113.91		0.63	x	0.1	=	67.14	(79)
Southwest	0.9x	0.77	x	13.5	x	104.39		0.63	x	0.1	=	61.53	(79)
Southwest	0.9x	0.77	x	13.5	x	92.85		0.63	x	0.1	=	54.73	(79)
Southwest	0.9x	0.77	x	13.5	x	69.27		0.63	x	0.1	=	40.83	(79)
Southwest	0.9x	0.77	x	13.5	x	44.07		0.63	x	0.1	=	25.98	(79)
Southwest	0.9x	0.77	x	13.5	x	31.49		0.63	x	0.1	=	18.56	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	23.13	39.87	55.83	71.3	81.81	82.07	78.77	70.8	61.17	44.41	27.79	19.74	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(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 internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.89	0.7	0.52	0.54	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.44	20.52	20.64	20.79	20.93	20.99	21	21	20.98	20.84	20.61	20.43	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.36	20.36	20.37	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.37	20.37	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.86	0.64	0.44	0.47	0.73	0.95	0.99	1	(89)

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

(90)m=	19.61	19.72	19.89	20.12	20.3	20.38	20.38	20.38	20.36	20.18	19.87	19.59	(90)

fLA = Living area ÷ (4) = | 0.51 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.03	20.12	20.27	20.46	20.62	20.69	20.69	20.69	20.67	20.51	20.25	20.01	(92)

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

(93)m=	19.88	19.97	20.12	20.31	20.47	20.54	20.54	20.54	20.52	20.36	20.1	19.86	(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	0.98	0.95	0.86	0.66	0.46	0.49	0.74	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	302.56	316.02	318.55	308.07	273.6	198.24	133.27	139.63	211.74	269.34	283.86	291.6	(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=	543.83	524.73	473.01	391.71	300.21	200.82	133.41	139.85	218.37	334.29	447.12	541.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	179.51	140.25	114.92	60.22	19.8	0	0	0	0	48.32	117.54	185.87	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 866.43 (98)

Space heating requirement in kWh/m²/year 16.76 (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) × [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)													
	179.51	140.25	114.92	60.22	19.8	0	0	0	0	48.32	117.54	185.87	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	199.67	156.01	127.83	66.98	22.03	0	0	0	0	53.75	130.75	206.75	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 963.78 (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

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	134.98	118.38	122.94	108.29	104.74	91.59	86.07	97.06	97.71	112.39	121.25	131.09

Efficiency of water heater 86.7 (216)

(217)m=	88.5	88.41	88.22	87.82	87.19	86.7	86.7	86.7	86.7	87.64	88.25	88.55	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	152.52	133.91	139.36	123.32	120.12	105.64	99.28	111.95	112.7	128.25	137.4	148.04

Total = Sum(219a)$_{1...12}$ = 1512.5 (219)

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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-hot				
mechanical ventilation - balanced, extract or positive 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 (230a)…(230g) =		196.42	(231)
Electricity for lighting			318.91	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions 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)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	101.94	(267)
Electricity for lighting	(232) x	0.519	=	165.52	(268)
Total CO2, kg/year		sum of (265)…(271) =		802.33	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.52	(273)
EI rating (section 14)				89	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 7

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	84.7	(1a) x	2.5	(2a) =	211.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	84.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		211.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.1	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(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	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			8.91	x1/[1/(0.73)+ 0.04] =	6.32			(27)
Windows Type 2			1.28	x1/[1/(0.73)+ 0.04] =	0.91			(27)
Windows Type 3			11.025	x1/[1/(0.73)+ 0.04] =	7.82			(27)
Windows Type 4			7.2	x1/[1/(0.73)+ 0.04] =	5.11			(27)
Windows Type 5			3.15	x1/[1/(0.73)+ 0.04] =	2.23			(27)
Walls Type1	27	8.91	18.09	x 0.15 =	2.71			(29)
Walls Type2	32.5	1.28	31.22	x 0.15 =	4.68			(29)
Walls Type3	14.5	11.02	3.48	x 0.15 =	0.52			(29)
Walls Type4	22	3.15	18.85	x 0.15 =	2.83			(29)
Walls Type5	9	7.2	1.8	x 0.15 =	0.27			(29)
Roof	84.7	0	84.7	x 0.11 =	9.32			(30)
Total area of elements, m²			189.7					(31)
Party wall			17.5	x 0 =	0			(32)
Party floor			84.7					(32a)
Internal wall **			126.5					(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	42.72	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14177.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		15.63	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	58.35	(37)

Ventilation heat loss calculated monthly (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 transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(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		
Average = Sum(39)$_{1…12}$ /12=													75.4	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(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		
Average = Sum(40)$_{1…12}$ /12=													0.89	(40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N	2.55	(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	94.67	(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(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		
Total = Sum(44)$_{1…12}$ =													1136.02	(44)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(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		
Total = Sum(45)$_{1…12}$ =													1489.5	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(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):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer’s declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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

Output from water heater (annual)$_{1...12}$ — 1628.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 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)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 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)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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. Solar gains:

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

DER WorkSheet: New dwelling design stage

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

West	0.9x	0.77	x	7.2	x	92.28	x	0.63	x	0.1	=	29.01	(80)
West	0.9x	0.77	x	7.2	x	113.09	x	0.63	x	0.1	=	35.55	(80)
West	0.9x	0.77	x	7.2	x	115.77	x	0.63	x	0.1	=	36.39	(80)
West	0.9x	0.77	x	7.2	x	110.22	x	0.63	x	0.1	=	34.65	(80)
West	0.9x	0.77	x	7.2	x	94.68	x	0.63	x	0.1	=	29.76	(80)
West	0.9x	0.77	x	7.2	x	73.59	x	0.63	x	0.1	=	23.13	(80)
West	0.9x	0.77	x	7.2	x	45.59	x	0.63	x	0.1	=	14.33	(80)
West	0.9x	0.77	x	7.2	x	24.49	x	0.63	x	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	x	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	x	11.02	x	28.07	x	0.63	x	0.1	=	13.51	(81)
Northwest	0.9x	0.77	x	11.02	x	14.2	x	0.63	x	0.1	=	6.83	(81)
Northwest	0.9x	0.77	x	11.02	x	9.21	x	0.63	x	0.1	=	4.44	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.61	57.41	87.27	121.46	147.29	150.92	143.56	123.74	99.11	65.88	38.53	26.61	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	424.55	447.55	462.43	472.99	475.01	456.17	434.65	421.6	409.59	400.2	399.86	408.01	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.88	0.72	0.76	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.01	20.09	20.25	20.48	20.72	20.91	20.98	20.97	20.85	20.55	20.24	19.99	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.16	20.16	20.17	20.18	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.95	0.82	0.6	0.65	0.9	0.99	1	1	(89)

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

(90)m=	18.82	18.94	19.18	19.52	19.86	20.11	20.18	20.17	20.04	19.62	19.17	18.8	(90)

fLA = Living area ÷ (4) = 0.3 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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 adjustment to the mean internal temperature from Table 4e, where appropriate

(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. 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	1	0.99	0.99	0.95	0.82	0.62	0.66	0.9	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)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)
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=	1129.07	1089.04	980.78	812.02	622.62	417.09	273.13	287.01	450.94	688.99	925.86	1125.05	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	524.66	431.84	387.46	249.2	128.01	0	0	0	0	219.22	379.63	533.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2853.88 (98)

Space heating requirement in kWh/m²/year 33.69 (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) × [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)													
	524.66	431.84	387.46	249.2	128.01	0	0	0	0	219.22	379.63	533.85	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	583.6	480.36	430.99	277.19	142.4	0	0	0	0	243.85	422.28	593.83	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3174.51 (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

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	166.28	145.76	151.19	132.92	128.36	111.98	104.96	118.74	119.65	137.97	149.17	161.4

Efficiency of water heater 86.7 (216)

(217)m=	89.11	89.07	88.98	88.76	88.27	86.7	86.7	86.7	86.7	88.64	88.97	89.14	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	186.6	163.64	169.92	149.75	145.42	129.16	121.07	136.96	138.01	155.65	167.66	181.07

Total = Sum(219a)$_{1...12}$ = 1844.9 (219)

DER WorkSheet: New dwelling design stage

Annual totals		**kWh/year**	**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 positive input from outside		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. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
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)
Space and water heating	(261) + (262) + (263) + (264) =				1084.19	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	138.41	(267)
Electricity for lighting	(232)	x	0.519	=	245.41	(268)
Total CO2, kg/year			sum of (265)…(271) =		1468.01	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.33	(273)
EI rating (section 14)					85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 8

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.8	(1a)	x	2.5	(2a)	=	124.5	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.8	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	124.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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			
Number of sides sheltered		3	(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

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) 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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.8	x1/[1/(0.73)+ 0.04]		=	7.66			(27)
Windows Type 2			2.475	x1/[1/(0.73)+ 0.04]		=	1.76			(27)
Walls Type1	19.5	10.8	8.7	x	0.15	=	1.31			(29)
Walls Type2	3.5	2.47	1.03	x	0.15	=	0.15			(29)
Total area of elements, m²			23							(31)
Party wall			51.75	x	0	=	0			(32)
Party floor			49.8							(32a)
Party ceiling			49.8							(32b)
Internal wall **			45.6							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	10.87	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13269.55	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		5.22	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	16.09	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	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 transfer coefficient, 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	

Average = $Sum(39)_{1…12}$ /12= 25.1 (39)

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Heat loss parameter (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

Average = Sum(40)$_{1…12}$ /12= 0.5 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 74.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = Sum(44)$_{1…12}$ = 890.4 (44)

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)

(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

Total = Sum(45)$_{1…12}$ = 1167.46 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 — 0 (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): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated 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 contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (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 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(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	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	11.76	10.62	11.74	11.35	11.71	11.32	11.69	11.7	11.33	11.73	11.37	11.76	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	132.8	116.48	120.98	106.58	103.1	90.18	84.76	95.56	96.19	110.62	119.31	128.98	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	132.8	116.48	120.98	106.58	103.1	90.18	84.76	95.56	96.19	110.62	119.31	128.98	

Output from water heater (annual)$_{1...12}$ 1305.54 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	43.19	37.85	39.26	34.5	33.31	29.05	27.22	30.81	31.05	35.81	38.73	41.92	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	146.71	148.24	144.4	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)
Water heating gains (Table 5)													
(72)m=	58.05	56.33	52.77	47.92	44.78	40.35	36.58	41.41	43.12	48.14	53.8	56.34	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	273.8	271.62	261.27	245.14	229.23	213.98	204.24	209.52	218.02	234.32	252.75	266.11	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	2.47	x	36.79	x	0.63	x	0.1	=	3.98	(77)
Southeast	0.9x	0.77	x	2.47	x	62.67	x	0.63	x	0.1	=	6.77	(77)
Southeast	0.9x	0.77	x	2.47	x	85.75	x	0.63	x	0.1	=	9.27	(77)
Southeast	0.9x	0.77	x	2.47	x	106.25	x	0.63	x	0.1	=	11.48	(77)
Southeast	0.9x	0.77	x	2.47	x	119.01	x	0.63	x	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	113.91	x	0.63	x	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	x	92.85	x	0.63	x	0.1	=	10.03	(77)
Southeast 0.9x	0.77	x	2.47	x	69.27	x	0.63	x	0.1	=	7.48	(77)
Southeast 0.9x	0.77	x	2.47	x	44.07	x	0.63	x	0.1	=	4.76	(77)
Southeast 0.9x	0.77	x	2.47	x	31.49	x	0.63	x	0.1	=	3.4	(77)
Southwest 0.9x	0.77	x	10.8	x	36.79		0.63	x	0.1	=	17.35	(79)
Southwest 0.9x	0.77	x	10.8	x	62.67		0.63	x	0.1	=	29.55	(79)
Southwest 0.9x	0.77	x	10.8	x	85.75		0.63	x	0.1	=	40.43	(79)
Southwest 0.9x	0.77	x	10.8	x	106.25		0.63	x	0.1	=	50.1	(79)
Southwest 0.9x	0.77	x	10.8	x	119.01		0.63	x	0.1	=	56.12	(79)
Southwest 0.9x	0.77	x	10.8	x	118.15		0.63	x	0.1	=	55.71	(79)
Southwest 0.9x	0.77	x	10.8	x	113.91		0.63	x	0.1	=	53.71	(79)
Southwest 0.9x	0.77	x	10.8	x	104.39		0.63	x	0.1	=	49.22	(79)
Southwest 0.9x	0.77	x	10.8	x	92.85		0.63	x	0.1	=	43.78	(79)
Southwest 0.9x	0.77	x	10.8	x	69.27		0.63	x	0.1	=	32.66	(79)
Southwest 0.9x	0.77	x	10.8	x	44.07		0.63	x	0.1	=	20.78	(79)
Southwest 0.9x	0.77	x	10.8	x	31.49		0.63	x	0.1	=	14.85	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(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=	295.12	307.94	310.97	306.72	298.2	282.45	270.25	270.02	271.84	274.47	278.29	284.36	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.91	0.77	0.56	0.4	0.42	0.63	0.88	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.71	20.77	20.85	20.94	20.99	21	21	21	21	20.96	20.83	20.69	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.51	20.51	20.51	20.52	20.52	20.53	20.53	20.53	20.52	20.52	20.52	20.51	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.89	0.73	0.52	0.36	0.38	0.58	0.86	0.97	0.99	(89)

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

(90)m=	20.12	20.2	20.32	20.45	20.51	20.53	20.53	20.53	20.52	20.48	20.3	20.1	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.4	20.47	20.57	20.68	20.73	20.75	20.75	20.75	20.75	20.71	20.55	20.38	(92)

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

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(93)m=	20.25	20.32	20.42	20.53	20.58	20.6	20.6	20.6	20.6	20.56	20.4	20.23	(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=	0.99	0.98	0.96	0.89	0.74	0.52	0.36	0.38	0.59	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)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 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=	409.43	394.66	355.23	292.22	222.47	147.78	98.51	103.12	161.08	249.27	335.19	406.46	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	87.45	62.34	42.78	14.54	2.19	0	0	0	0	9.65	46.85	92.6	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 358.4 (98)

Space heating requirement in kWh/m²/year 7.2 (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) × [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)														
	87.45	62.34	42.78	14.54	2.19	0	0	0	0	9.65	46.85	92.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	97.27	69.34	47.59	16.17	2.44	0	0	0	0	10.73	52.12	103		
Total (kWh/year) =$Sum(211)_{1...5,10....12}$=													398.67	(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		
Total (kWh/year) =$Sum(215)_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	132.8	116.48	120.98	106.58	103.1	90.18	84.76	95.56	96.19	110.62	119.31	128.98		
Efficiency of water heater													86.7	(216)
(217)m=	87.94	87.79	87.51	87.07	86.76	86.7	86.7	86.7	86.7	86.95	87.58	88.01		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	151.01	132.68	138.24	122.41	118.82	104.01	97.76	110.21	110.94	127.22	136.24	146.55		
Total = $Sum(219a)_{1...12}$ =													1496.11	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		398.67

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Water heating fuel used		1496.11	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
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) + (263) + (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) =		671.81	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.49	(273)
EI rating (section 14)				91	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.23

Property Address: Flat 1

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.7	(1a) x	2.5	(2a) =	129.25	(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:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.08	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.35	x	1/[1/(0.73)+ 0.04]	=	7.34			(27)
Windows Type 2			4.51	x	1/[1/(0.73)+ 0.04]	=	3.2			(27)
Floor			51.7	x	0.06	=	3.102			(28)
Walls Type1	19.75	10.35	9.4	x	0.15	=	1.41			(29)
Walls Type2	14.75	4.51	10.24	x	0.15	=	1.54			(29)
Walls Type3	20	0	20	x	0.15	=	3			(29)
Total area of elements, m²			106.2							(31)
Party wall			20	x	0	=	0			(32)
Party ceiling			51.7							(32b)
Internal wall **			77							(32c)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.59 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11299.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.55 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(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 transfer coefficient, W/K (39)m = (37) + (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	

Average = $Sum(39)_{1...12}$ /12= 37.25 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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

Average = $Sum(40)_{1...12}$ /12= 0.72 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.74 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 75.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	83.08	80.06	77.04	74.02	71	67.98	67.98	71	74.02	77.04	80.06	83.08

Total = $Sum(44)_{1...12}$ = 906.36 (44)

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)

(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

Total = $Sum(45)_{1...12}$ = 1188.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 180 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.87 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.97 (54)

Enter (50) or (54) in (55) 0.97 (55)

Water storage loss calculated 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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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)

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Primary circuit loss (annual) from Table 3												0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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	
									Output from water heater (annual)$_{1...12}$			1816.58	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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 calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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	87.01	87.01	87.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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 gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (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	x	0.63	x	0.1	=	4.52	(75)

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Northeast 0.9x	0.77	x	4.51	x	41.38	x	0.63	x	0.1	=	8.15	(75)
Northeast 0.9x	0.77	x	4.51	x	67.96	x	0.63	x	0.1	=	13.38	(75)
Northeast 0.9x	0.77	x	4.51	x	91.35	x	0.63	x	0.1	=	17.99	(75)
Northeast 0.9x	0.77	x	4.51	x	97.38	x	0.63	x	0.1	=	19.18	(75)
Northeast 0.9x	0.77	x	4.51	x	91.1	x	0.63	x	0.1	=	17.94	(75)
Northeast 0.9x	0.77	x	4.51	x	72.63	x	0.63	x	0.1	=	14.3	(75)
Northeast 0.9x	0.77	x	4.51	x	50.42	x	0.63	x	0.1	=	9.93	(75)
Northeast 0.9x	0.77	x	4.51	x	28.07	x	0.63	x	0.1	=	5.53	(75)
Northeast 0.9x	0.77	x	4.51	x	14.2	x	0.63	x	0.1	=	2.8	(75)
Northeast 0.9x	0.77	x	4.51	x	9.21	x	0.63	x	0.1	=	1.81	(75)
Southwest0.9x	0.77	x	10.35	x	36.79		0.63	x	0.1	=	16.63	(79)
Southwest0.9x	0.77	x	10.35	x	62.67		0.63	x	0.1	=	28.32	(79)
Southwest0.9x	0.77	x	10.35	x	85.75		0.63	x	0.1	=	38.75	(79)
Southwest0.9x	0.77	x	10.35	x	106.25		0.63	x	0.1	=	48.01	(79)
Southwest0.9x	0.77	x	10.35	x	119.01		0.63	x	0.1	=	53.78	(79)
Southwest0.9x	0.77	x	10.35	x	118.15		0.63	x	0.1	=	53.39	(79)
Southwest0.9x	0.77	x	10.35	x	113.91		0.63	x	0.1	=	51.47	(79)
Southwest0.9x	0.77	x	10.35	x	104.39		0.63	x	0.1	=	47.17	(79)
Southwest0.9x	0.77	x	10.35	x	92.85		0.63	x	0.1	=	41.96	(79)
Southwest0.9x	0.77	x	10.35	x	69.27		0.63	x	0.1	=	31.3	(79)
Southwest0.9x	0.77	x	10.35	x	44.07		0.63	x	0.1	=	19.91	(79)
Southwest0.9x	0.77	x	10.35	x	31.49		0.63	x	0.1	=	14.23	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)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 – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	350.27	362.06	365.5	363.43	357.42	342.54	329.38	326.81	325.96	327.64	332.45	339.55	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.87	0.67	0.49	0.51	0.75	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.44	20.51	20.63	20.79	20.93	20.99	21	21	20.98	20.85	20.62	20.42	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.31	20.31	20.31	20.32	20.32	20.33	20.33	20.33	20.33	20.32	20.32	20.32	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.94	0.83	0.61	0.42	0.44	0.69	0.92	0.98	0.99	(89)

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

(90)m=	19.56	19.66	19.84	20.08	20.25	20.33	20.33	20.33	20.31	20.15	19.84	19.55	(90)

fLA = Living area ÷ (4) = | 0.5 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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)

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

(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)

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=	0.99	0.99	0.98	0.94	0.84	0.64	0.45	0.48	0.72	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(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)
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=	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)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	184.57	145.81	120.19	63.31	21.45	0	0	0	0	48.12	118.41	190.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 892.02 (98)

Space heating requirement in kWh/m²/year 17.25 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		892.02	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	892.02	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1816.58	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1816.58	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	27.09	(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)

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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 kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
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	=	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) x		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)) x		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	x 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)
EI rating (section 14)					96.05	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.4.23

Property Address: Flat 2

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	77.9	(1a) x	2.5	(2a) =	194.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.9	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		194.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *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*		0	(11)
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) ÷ 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) ÷ 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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.08	(21)

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												
(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			9.45	x	1/[1/(0.73)+ 0.04]	=	6.7			(27)
Windows Type 2			3.15	x	1/[1/(0.73)+ 0.04]	=	2.23			(27)
Walls Type1	10.05	9.45	0.6	x	0.15	=	0.09			(29)
Walls Type2	14.5	0	14.5	x	0.15	=	2.18			(29)
Walls Type3	5.35	3.15	2.2	x	0.15	=	0.33			(29)
Total area of elements, m²			29.9							(31)
Party wall			32	x	0	=	0			(32)
Party wall			33	x	0	=	0			(32)
Party floor			77.9							(32a)
Party ceiling			77.9							(32b)
Internal wall **			82.5							(32c)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 11.53 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15893.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.02 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 17.55 (37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (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 transfer coefficient, 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	

Average = $Sum(39)_{1\ldots12}$ /12= 32.17 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = $Sum(40)_{1\ldots12}$ /12= 0.41 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.42 (42)
  if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
  if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.72 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	100.89	97.22	93.55	89.88	86.21	82.55	82.55	86.21	89.88	93.55	97.22	100.89	

Total = $Sum(44)_{1\ldots12}$ = 1100.62 (44)

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)

(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 = $Sum(45)_{1\ldots12}$ = 1443.08 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.44	19.63	20.25	17.66	16.94	14.62	13.55	15.55	15.73	18.34	20.01	21.73	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 180 (50)

 b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.87 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.97 (54)

 Enter (50) or (54) in (55) 0.97 (55)

Water storage loss calculated 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)

DER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	202.97	179.05	188.38	169.36	166.31	149.11	143.68	157	156.52	175.59	185.06	198.25	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	202.97	179.05	188.38	169.36	166.31	149.11	143.68	157	156.52	175.59	185.06	198.25

Output from water heater (annual)$_{1…12}$ — 2071.28 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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 (calculated in Appendix L, equation L9 or L9a), also 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 5)

(72)m=	124.23	122.12	117.72	111.73	107.85	102.38	97.74	103.69	105.81	112	118.99	122.12	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	425.56	422.66	408.16	385.47	362.75	341.36	327.98	334.72	346.94	369.84	395.66	414.72	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.1	=	1.55	(75)
Northeast	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.1	=	3.16	(75)
Northeast	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.1	=	5.69	(75)
Northeast	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.1	=	9.35	(75)
Northeast	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.1	=	12.56	(75)
Northeast	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.1	=	13.39	(75)
Northeast	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.1	=	12.53	(75)
Northeast	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.1	=	9.99	(75)
Northeast	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.1	=	6.93	(75)
Northeast	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.1	=	3.86	(75)
Northeast	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.1	=	1.95	(75)
Northeast	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.1	=	1.27	(75)
Southwest	0.9x	0.77	x	9.45	x	36.79		0.63	x	0.1	=	15.18	(79)
Southwest	0.9x	0.77	x	9.45	x	62.67		0.63	x	0.1	=	25.86	(79)
Southwest	0.9x	0.77	x	9.45	x	85.75		0.63	x	0.1	=	35.38	(79)
Southwest	0.9x	0.77	x	9.45	x	106.25		0.63	x	0.1	=	43.84	(79)
Southwest	0.9x	0.77	x	9.45	x	119.01		0.63	x	0.1	=	49.1	(79)
Southwest	0.9x	0.77	x	9.45	x	118.15		0.63	x	0.1	=	48.75	(79)
Southwest	0.9x	0.77	x	9.45	x	113.91		0.63	x	0.1	=	47	(79)
Southwest	0.9x	0.77	x	9.45	x	104.39		0.63	x	0.1	=	43.07	(79)
Southwest	0.9x	0.77	x	9.45	x	92.85		0.63	x	0.1	=	38.31	(79)
Southwest	0.9x	0.77	x	9.45	x	69.27		0.63	x	0.1	=	28.58	(79)
Southwest	0.9x	0.77	x	9.45	x	44.07		0.63	x	0.1	=	18.18	(79)
Southwest	0.9x	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)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)

7. Mean internal temperature (heating season)

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)

	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	0.37	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	20.98	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	20.59	20.6	20.6	20.61	20.61	20.61	20.61	20.6	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)

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

DER WorkSheet: New dwelling design stage

(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 internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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 adjustment to the mean internal temperature from Table 4e, where appropriate

(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)

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	0.97	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)
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=	538.71	518.26	465.77	380.98	290.16	193.16	130.39	136.1	210.61	325.21	438.69	532.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	77.88	53.86	32.89	7.65	0.65	0	0	0	0	3.65	32.59	82.13	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 291.3 (98)

Space heating requirement in kWh/m²/year 3.74 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)
Space heating		**kWh/year**	
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) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2071.28	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2071.28	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	23.63	(313)

DER WorkSheet: New dwelling design stage

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 outside		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) + (330b) + (330g) =	182.95	(331)
Energy for lighting (calculated in Appendix L)		476.95	(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 kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) 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	=	336.86	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	12.26	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	349.12	(373)
CO2 associated with space heating (secondary)	(309) x		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) =				349.12	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	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 Item 1		0.52	x 0.01 =		-345.13	(380)
Total CO2, kg/year	sum of (376)…(382) =				346.48	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				4.45	(384)
EI rating (section 14)					96.22	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 3

Address : 3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.8	(1a) x	2.5	(2a) =	124.5	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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

Number of sides sheltered		3	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) 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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.8	x	1/[1/(0.73)+ 0.04]	=	7.66			(27)
Windows Type 2			2.475	x	1/[1/(0.73)+ 0.04]	=	1.76			(27)
Walls Type1	19.5	10.8	8.7	x	0.15	=	1.31			(29)
Walls Type2	3.5	2.47	1.03	x	0.15	=	0.15			(29)
Total area of elements, m²			23							(31)
Party wall			51.75	x	0	=	0			(32)
Party floor			49.8							(32a)
Party ceiling			49.8							(32b)
Internal wall **			45.6							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 10.87 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13269.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.22 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 16.09 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	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 transfer coefficient, 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	

Average = Sum(39)$_{1…12}$ /12= 25.1 (39)

Heat loss parameter (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

Average = Sum(40)$_{1…12}$ /12= 0.5 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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	66.78	69.75	72.72	75.68	78.65	81.62	
										Total = Sum(44)$_{1…12}$ =		890.4	(44)
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)													
(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	
										Total = Sum(45)$_{1…12}$ =		1167.46	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(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 180 (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): 1.85 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.11 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.11 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)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 cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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 (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each 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	134.67	130.75	141.52	140.67	156.56	163.76	174.89	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	178.71	157.95	166.91	151.05	149.06	134.67	130.75	141.52	140.67	156.56	163.76	174.89	

Output from water heater (annual)$_{1...12}$ 1846.5 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.38	76.87	82.46	76.32	76.52	70.87	70.43	74.02	72.86	79.02	80.54	85.11	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	146.71	148.24	144.4	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(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. evaporation (negative values) (Table 5)

(71)m=	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)

Water heating gains (Table 5)

(72)m=	116.11	114.39	110.83	106	102.85	98.43	94.67	99.49	101.2	106.21	111.86	114.4	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	328.86	326.68	316.34	300.21	284.31	269.06	259.32	264.6	273.1	289.39	307.81	321.17	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	2.47	x	36.79	x	0.63	x	0.1	=	3.98	(77)
Southeast 0.9x	0.77	x	2.47	x	62.67	x	0.63	x	0.1	=	6.77	(77)
Southeast 0.9x	0.77	x	2.47	x	85.75	x	0.63	x	0.1	=	9.27	(77)
Southeast 0.9x	0.77	x	2.47	x	106.25	x	0.63	x	0.1	=	11.48	(77)
Southeast 0.9x	0.77	x	2.47	x	119.01	x	0.63	x	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	113.91	x	0.63	x	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	x	92.85	x	0.63	x	0.1	=	10.03	(77)
Southeast 0.9x	0.77	x	2.47	x	69.27	x	0.63	x	0.1	=	7.48	(77)
Southeast 0.9x	0.77	x	2.47	x	44.07	x	0.63	x	0.1	=	4.76	(77)
Southeast 0.9x	0.77	x	2.47	x	31.49	x	0.63	x	0.1	=	3.4	(77)
Southwest 0.9x	0.77	x	10.8	x	36.79		0.63	x	0.1	=	17.35	(79)
Southwest 0.9x	0.77	x	10.8	x	62.67		0.63	x	0.1	=	29.55	(79)
Southwest 0.9x	0.77	x	10.8	x	85.75		0.63	x	0.1	=	40.43	(79)
Southwest 0.9x	0.77	x	10.8	x	106.25		0.63	x	0.1	=	50.1	(79)
Southwest 0.9x	0.77	x	10.8	x	119.01		0.63	x	0.1	=	56.12	(79)
Southwest 0.9x	0.77	x	10.8	x	118.15		0.63	x	0.1	=	55.71	(79)
Southwest 0.9x	0.77	x	10.8	x	113.91		0.63	x	0.1	=	53.71	(79)
Southwest 0.9x	0.77	x	10.8	x	104.39		0.63	x	0.1	=	49.22	(79)
Southwest 0.9x	0.77	x	10.8	x	92.85		0.63	x	0.1	=	43.78	(79)
Southwest 0.9x	0.77	x	10.8	x	69.27		0.63	x	0.1	=	32.66	(79)
Southwest 0.9x	0.77	x	10.8	x	44.07		0.63	x	0.1	=	20.78	(79)
Southwest 0.9x	0.77	x	10.8	x	31.49		0.63	x	0.1	=	14.85	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(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	363	366.04	361.79	353.28	337.54	325.34	325.11	326.91	329.54	333.36	339.42	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.96	0.91	0.81	0.66	0.47	0.33	0.35	0.52	0.77	0.93	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.81	20.86	20.92	20.98	21	21	21	21	21	20.99	20.91	20.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.51	20.51	20.51	20.52	20.52	20.53	20.53	20.53	20.52	20.52	20.52	20.51	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.9	0.79	0.62	0.43	0.3	0.31	0.49	0.74	0.92	0.97	(89)

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

(90)m=	20.26	20.33	20.42	20.5	20.52	20.53	20.53	20.53	20.52	20.51	20.41	20.25	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)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	(92)

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

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(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)

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=	0.97	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 (84)m													
(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)
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=	416.48	401.35	361.22	296.95	226.39	151.48	102.2	106.8	164.82	253.71	341.39	413.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	57.96	38.53	22.77	5.77	0.65	0	0	0	0	3.18	24.81	62.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 215.73 (98)

Space heating requirement in kWh/m²/year 4.33 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		215.73	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	215.73	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1846.5	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1846.5	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.62	(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 outside		116.96	(330a)

DER WorkSheet: New dwelling design stage

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

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
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	=	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 instantaneous 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 dwelling	(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 applicable						
Item 1		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)
EI rating (section 14)					97.41	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 4

Address : 3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	92.6	(1a) x	2.5	(2a) =	231.5	(3a)
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 heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.08	(21)

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												
(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.98	x1/[1/(0.73)+ 0.04] =			7.79			(27)
Windows Type 2			2.7	x1/[1/(0.73)+ 0.04] =			1.92			(27)
Windows Type 3			2.7	x1/[1/(0.73)+ 0.04] =			1.92			(27)
Walls Type1	34.5	10.98	23.52	x	0.15	=	3.53			(29)
Walls Type2	12.5	2.7	9.8	x	0.15	=	1.47			(29)
Walls Type3	23.25	2.7	20.55	x	0.15	=	3.08			(29)
Total area of elements, m²			70.25							(31)
Party wall			47	x	0	=	0			(32)
Party floor			92.6							(32a)
Party ceiling			92.6							(32b)
Internal wall **			146.5							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	19.7	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	19835.1	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		7.32	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	27.02	(37)

Ventilation heat loss calculated monthly (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 transfer coefficient, 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	

Average = Sum(39)$_{1\ldots12}$ /12= 44.4 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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	

Average = Sum(40)$_{1\ldots12}$ /12= 0.48 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.66 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.37 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	107.1	103.21	99.31	95.42	91.52	87.63	87.63	91.52	95.42	99.31	103.21	107.1	

Total = Sum(44)$_{1\ldots12}$ = 1168.4 (44)

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)

(45)m=	158.83	138.92	143.35	124.97	119.92	103.48	95.89	110.03	111.35	129.76	141.65	153.82	

Total = Sum(45)$_{1\ldots12}$ = 1531.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 180 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.87 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.97 (54)

Enter (50) or (54) in (55) 0.97 (55)

Water storage loss calculated 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)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	212.19	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 input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	212.19	187.11	196.7	176.61	173.27	155.11	149.24	163.39	162.98	183.12	193.28	207.17

Output from water heater (annual)$_{1...12}$ — 2160.16 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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 (calculated in Appendix L, equation L9 or L9a), also see Table 5

(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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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. evaporation (negative values) (Table 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 gains (Table 5)

(72)m=	128.35	126.1	121.43	115.08	110.96	105.16	100.22	106.54	108.79	115.36	122.78	126.11	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	465.49	462.36	446.27	421	395.54	371.7	356.85	364.05	377.72	403.21	431.97	453.34	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Northeast	0.9x	0.77	x	2.7	x	11.28	x	0.63	x	0.1	=	1.33	(75)
Northeast	0.9x	0.77	x	2.7	x	22.97	x	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	x	0.63	x	0.1	=	8.01	(75)
Northeast	0.9x	0.77	x	2.7	x	91.35	x	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	x	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	x	0.63	x	0.1	=	7.39	(77)
Southeast	0.9x	0.77	x	2.7	x	85.75	x	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	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	x	0.63	x	0.1	=	13.43	(77)
Southeast	0.9x	0.77	x	2.7	x	104.39	x	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	x	69.27	x	0.63	x	0.1	=	8.17	(77)
Southeast	0.9x	0.77	x	2.7	x	44.07	x	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	0.9x	0.77	x	10.98	x	36.79		0.63	x	0.1	=	17.64	(79)
Southwest	0.9x	0.77	x	10.98	x	62.67		0.63	x	0.1	=	30.04	(79)
Southwest	0.9x	0.77	x	10.98	x	85.75		0.63	x	0.1	=	41.11	(79)
Southwest	0.9x	0.77	x	10.98	x	106.25		0.63	x	0.1	=	50.93	(79)
Southwest	0.9x	0.77	x	10.98	x	119.01		0.63	x	0.1	=	57.05	(79)
Southwest	0.9x	0.77	x	10.98	x	118.15		0.63	x	0.1	=	56.64	(79)
Southwest	0.9x	0.77	x	10.98	x	113.91		0.63	x	0.1	=	54.61	(79)
Southwest	0.9x	0.77	x	10.98	x	104.39		0.63	x	0.1	=	50.04	(79)
Southwest	0.9x	0.77	x	10.98	x	92.85		0.63	x	0.1	=	44.51	(79)
Southwest	0.9x	0.77	x	10.98	x	69.27		0.63	x	0.1	=	33.21	(79)
Southwest	0.9x	0.77	x	10.98	x	44.07		0.63	x	0.1	=	21.13	(79)
Southwest	0.9x	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)

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)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	0.99	0.99	0.95	0.83	0.61	0.44	0.46	0.68	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.68	20.73	20.81	20.92	20.98	21	21	21	21	20.95	20.81	20.67	(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	0.99	0.98	0.93	0.8	0.57	0.39	0.41	0.64	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=	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)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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 adjustment to the mean internal temperature from Table 4e, where appropriate

(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. 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=	0.99	0.99	0.98	0.94	0.81	0.58	0.41	0.43	0.66	0.91	0.98	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(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)
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=	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 heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	180.9	137.35	104.12	42.39	7.99	0	0	0	0	27.28	103.29	187.28	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 790.59 (98)

Space heating requirement in kWh/m²/year 8.54 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)

Space heating	**kWh/year**
Annual space heating requirement	790.59

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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 Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2160.16	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2160.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (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 outside		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) + (330b) + (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 quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) 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	=	420.72	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	15.31	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	436.04	(373)
CO2 associated with space heating (secondary)	(309) x		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) =				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	(332))) x		0.52	=	279.2	(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) =				470.88	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				5.09	(384)
EI rating (section 14)					95.41	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 5

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	76.8	(1a)	x	2.5	(2a)	=	192	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.8	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			192	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.09	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(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)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.7	x	1/[1/(0.73)+ 0.04]	=	1.92			(27)
Windows Type 2			3.6	x	1/[1/(0.73)+ 0.04]	=	2.55			(27)
Windows Type 3			7.2	x	1/[1/(0.73)+ 0.04]	=	5.11			(27)
Windows Type 4			4.94	x	1/[1/(0.73)+ 0.04]	=	3.5			(27)
Walls Type1	5	2.7	2.3	x	0.15	=	0.35			(29)
Walls Type2	31.5	3.6	27.9	x	0.15	=	4.19			(29)
Walls Type3	22.75	7.2	15.55	x	0.15	=	2.33			(29)
Walls Type4	15	4.94	10.06	x	0.15	=	1.51			(29)
Total area of elements, m²			74.25							(31)
Party wall			37.5	x	0	=	0			(32)
Party floor			76.8							(32a)
Party ceiling			76.8							(32b)
Internal wall **			117							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	21.45	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16870.8	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K	7.99	(36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 29.44 (37)

Ventilation heat loss calculated monthly (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 transfer coefficient, 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)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(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

Average = Sum(40)$_{1…12}$ /12= 0.58 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.4 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.18 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

Total = Sum(44)$_{1…12}$ = 1094.21 (44)

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)

(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 = Sum(45)$_{1…12}$ = 1434.68 (45)

If instantaneous water heating at point of use (no hot water 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)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 180 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.87 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.97 (54)

Enter (50) or (54) in (55) 0.97 (55)

Water storage loss calculated 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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(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 DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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

Output from water heater (annual)$_{1...12}$ | 2062.88 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	68.07	60.07	63.25	56.92	55.95	50.23	48.47	52.87	52.68	59.02	62.12	66.51	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	25.99	23.09	18.78	14.21	10.63	8.97	9.69	12.6	16.91	21.47	25.06	26.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 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)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35	35	35	35	35	35	35	35	35	35	35	35	(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. evaporation (negative values) (Table 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 (Table 5)

(72)m=	91.49	89.38	85.01	79.06	75.2	69.77	65.15	71.07	73.17	79.32	86.27	89.39	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	389.1	386.29	372.04	349.7	327.31	306.17	292.9	299.52	311.49	334.04	359.52	378.34	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (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	0.9x	0.77	x	2.7	x	36.79		0.63	x	0.1	=	4.34	(79)
Southwest	0.9x	0.77	x	2.7	x	62.67		0.63	x	0.1	=	7.39	(79)
Southwest	0.9x	0.77	x	2.7	x	85.75		0.63	x	0.1	=	10.11	(79)
Southwest	0.9x	0.77	x	2.7	x	106.25		0.63	x	0.1	=	12.52	(79)
Southwest	0.9x	0.77	x	2.7	x	119.01		0.63	x	0.1	=	14.03	(79)
Southwest	0.9x	0.77	x	2.7	x	118.15		0.63	x	0.1	=	13.93	(79)
Southwest	0.9x	0.77	x	2.7	x	113.91		0.63	x	0.1	=	13.43	(79)
Southwest	0.9x	0.77	x	2.7	x	104.39		0.63	x	0.1	=	12.31	(79)
Southwest	0.9x	0.77	x	2.7	x	92.85		0.63	x	0.1	=	10.95	(79)
Southwest	0.9x	0.77	x	2.7	x	69.27		0.63	x	0.1	=	8.17	(79)
Southwest	0.9x	0.77	x	2.7	x	44.07		0.63	x	0.1	=	5.2	(79)
Southwest	0.9x	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)

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Northwest	0.9x	0.77	x	7.2	x	67.96	x	0.63	x	0.1	=	21.36	(81)
Northwest	0.9x	0.77	x	7.2	x	91.35	x	0.63	x	0.1	=	28.71	(81)
Northwest	0.9x	0.77	x	7.2	x	97.38	x	0.63	x	0.1	=	30.61	(81)
Northwest	0.9x	0.77	x	7.2	x	91.1	x	0.63	x	0.1	=	28.64	(81)
Northwest	0.9x	0.77	x	7.2	x	72.63	x	0.63	x	0.1	=	22.83	(81)
Northwest	0.9x	0.77	x	7.2	x	50.42	x	0.63	x	0.1	=	15.85	(81)
Northwest	0.9x	0.77	x	7.2	x	28.07	x	0.63	x	0.1	=	8.82	(81)
Northwest	0.9x	0.77	x	7.2	x	14.2	x	0.63	x	0.1	=	4.46	(81)
Northwest	0.9x	0.77	x	7.2	x	9.21	x	0.63	x	0.1	=	2.9	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	13.89	26.5	43.27	64.47	81.49	84.81	80.15	66.97	50.59	31.23	17.17	11.54	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	402.99	412.79	415.31	414.17	408.8	390.99	373.05	366.48	362.08	365.27	376.69	389.88	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.9	0.7	0.51	0.54	0.8	0.97	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.51	20.57	20.67	20.82	20.94	20.99	21	21	20.98	20.86	20.67	20.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.44	20.44	20.44	20.45	20.45	20.46	20.46	20.46	20.46	20.45	20.45	20.44	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.87	0.65	0.45	0.48	0.75	0.96	0.99	1	(89)

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

(90)m=	19.78	19.86	20.01	20.23	20.39	20.46	20.46	20.46	20.44	20.28	20.01	19.77	(90)

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.03	20.1	20.23	20.43	20.58	20.64	20.64	20.65	20.63	20.48	20.23	20.02	(92)

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

(93)m=	20.03	20.1	20.23	20.43	20.58	20.64	20.64	20.65	20.63	20.48	20.23	20.02	(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	1	0.99	0.97	0.88	0.67	0.47	0.5	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	401.87	410.99	411.32	400.85	360.47	260.67	175.98	184.04	278.4	351.1	374.09	389.04	(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=	714.73	688.41	620.02	512.02	393.08	262.98	176.08	184.21	286.14	437.25	585.2	709.52	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	232.77	186.43	155.27	80.04	24.27	0	0	0	0	64.1	152	238.43

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1133.31 (98)

Space heating requirement in kWh/m²/year 14.76 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1133.31	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1133.31	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2062.88	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2062.88	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	31.96	(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 outside		173.81	(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) =	173.81	(331)
Energy for lighting (calculated in Appendix L)		459.05	(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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		364	(367a)

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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)...(372)		=	472.31	(373)
CO2 associated with space heating (secondary)	(309) x	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) =			472.31	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	90.21	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	238.25	(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) =			455.63	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			5.93	(384)
EI rating (section 14)				94.99	(385)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 6

Address : 1 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.7	(1a) x	2.5	(2a) =	129.25	(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:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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

Number of sides sheltered		3	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed 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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) 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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			13.5	x	1/[1/(0.73)+ 0.04]	=	9.58			(27)
Windows Type 2			2.925	x	1/[1/(0.73)+ 0.04]	=	2.07			(27)
Walls Type1	29	13.5	15.5	x	0.15	=	2.33			(29)
Walls Type2	5	2.92	2.08	x	0.15	=	0.31			(29)
Walls Type3	18	0	18	x	0.15	=	2.7			(29)
Total area of elements, m²			52							(31)
Party wall			44.25	x	0	=	0			(32)
Party floor			51.7							(32a)
Party ceiling			51.7							(32b)
Internal wall **			77							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 16.99 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13882.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 24.95 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(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 transfer coefficient, W/K (39)m = (37) + (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	

Average = $Sum(39)_{1...12}$ /12= 34.3 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.68	0.67	0.67	0.66	0.66	0.65	0.65	0.65	0.66	0.66	0.67	0.67

Average = $Sum(40)_{1...12}$ /12= 0.66 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.74 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 75.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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=	83.08	80.06	77.04	74.02	71	67.98	67.98	71	74.02	77.04	80.06	83.08

Total = $Sum(44)_{1...12}$ = 906.36 (44)

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)

(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

Total = $Sum(45)_{1...12}$ = 1188.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 180 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.87 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.97 (54)

Enter (50) or (54) in (55) 0.97 (55)

Water storage loss calculated 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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)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 Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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	

Output from water heater (annual)1…12 | 1816.58 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(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 calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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	87.01	87.01	87.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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 gains (calculated in Appendix L, equation L13 or L13a), also see Table 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 (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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 gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	2.92	x	11.28	x	0.63	x	0.1	=	1.44	(75)
Northeast 0.9x	0.77	x	2.92	x	22.97	x	0.63	x	0.1	=	2.93	(75)

Northeast	0.9x	0.77	x	2.92	x	41.38	x	0.63	x	0.1	=	5.28	(75)
Northeast	0.9x	0.77	x	2.92	x	67.96	x	0.63	x	0.1	=	8.68	(75)
Northeast	0.9x	0.77	x	2.92	x	91.35	x	0.63	x	0.1	=	11.67	(75)
Northeast	0.9x	0.77	x	2.92	x	97.38	x	0.63	x	0.1	=	12.44	(75)
Northeast	0.9x	0.77	x	2.92	x	91.1	x	0.63	x	0.1	=	11.63	(75)
Northeast	0.9x	0.77	x	2.92	x	72.63	x	0.63	x	0.1	=	9.27	(75)
Northeast	0.9x	0.77	x	2.92	x	50.42	x	0.63	x	0.1	=	6.44	(75)
Northeast	0.9x	0.77	x	2.92	x	28.07	x	0.63	x	0.1	=	3.58	(75)
Northeast	0.9x	0.77	x	2.92	x	14.2	x	0.63	x	0.1	=	1.81	(75)
Northeast	0.9x	0.77	x	2.92	x	9.21	x	0.63	x	0.1	=	1.18	(75)
Southwest	0.9x	0.77	x	13.5	x	36.79		0.63	x	0.1	=	21.69	(79)
Southwest	0.9x	0.77	x	13.5	x	62.67		0.63	x	0.1	=	36.94	(79)
Southwest	0.9x	0.77	x	13.5	x	85.75		0.63	x	0.1	=	50.54	(79)
Southwest	0.9x	0.77	x	13.5	x	106.25		0.63	x	0.1	=	62.62	(79)
Southwest	0.9x	0.77	x	13.5	x	119.01		0.63	x	0.1	=	70.14	(79)
Southwest	0.9x	0.77	x	13.5	x	118.15		0.63	x	0.1	=	69.64	(79)
Southwest	0.9x	0.77	x	13.5	x	113.91		0.63	x	0.1	=	67.14	(79)
Southwest	0.9x	0.77	x	13.5	x	104.39		0.63	x	0.1	=	61.53	(79)
Southwest	0.9x	0.77	x	13.5	x	92.85		0.63	x	0.1	=	54.73	(79)
Southwest	0.9x	0.77	x	13.5	x	69.27		0.63	x	0.1	=	40.83	(79)
Southwest	0.9x	0.77	x	13.5	x	44.07		0.63	x	0.1	=	25.98	(79)
Southwest	0.9x	0.77	x	13.5	x	31.49		0.63	x	0.1	=	18.56	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	23.13	39.87	55.83	71.3	81.81	82.07	78.77	70.8	61.17	44.41	27.79	19.74	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	354.37	368.92	374.29	373.23	367.39	351.99	338.67	336.05	335.12	335.07	337.35	343.05	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.82	0.61	0.44	0.46	0.69	0.91	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.54	20.61	20.72	20.86	20.96	21	21	21	20.99	20.9	20.71	20.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.36	20.36	20.37	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.37	20.37	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.91	0.78	0.55	0.38	0.4	0.63	0.89	0.97	0.99	(89)

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

(90)m=	19.75	19.85	20.02	20.22	20.34	20.38	20.38	20.38	20.37	20.27	20	19.73	(90)

fLA = Living area ÷ (4) = | 0.51 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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)

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

(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)

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=	0.99	0.98	0.97	0.92	0.79	0.58	0.41	0.43	0.66	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(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)
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=	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 heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	150.83	115.22	89.51	41.46	11.07	0	0	0	0	30.64	91.64	156.8	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 687.17 (98)

Space heating requirement in kWh/m²/year 13.29 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		687.17	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	687.17	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1816.58	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1816.58	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.04	(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)

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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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) 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) x		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)) x		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)
EI rating (section 14)				96.49	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 7

Address : 2 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	84.7	(1a) x	2.5	(2a) =	211.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	84.7	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	211.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.1	(21)

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												
(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(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	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			8.91	x1/[1/(0.73)+ 0.04] =			6.32			(27)
Windows Type 2			1.28	x1/[1/(0.73)+ 0.04] =			0.91			(27)
Windows Type 3			11.025	x1/[1/(0.73)+ 0.04] =			7.82			(27)
Windows Type 4			7.2	x1/[1/(0.73)+ 0.04] =			5.11			(27)
Windows Type 5			3.15	x1/[1/(0.73)+ 0.04] =			2.23			(27)
Walls Type1	27	8.91	18.09	x	0.15	=	2.71			(29)
Walls Type2	32.5	1.28	31.22	x	0.15	=	4.68			(29)
Walls Type3	14.5	11.02	3.48	x	0.15	=	0.52			(29)
Walls Type4	22	3.15	18.85	x	0.15	=	2.83			(29)
Walls Type5	9	7.2	1.8	x	0.15	=	0.27			(29)
Roof	84.7	0	84.7	x	0.11	=	9.32			(30)
Total area of elements, m²			189.7							(31)
Party wall			17.5	x	0	=	0			(32)
Party floor			84.7							(32a)
Internal wall **			126.5							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	42.72	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14177.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		15.63	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	58.35	(37)

Ventilation heat loss calculated monthly — (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 transfer coefficient, 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	

Average = $Sum(39)_{1…12}$ /12= 75.4 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(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	

Average = $Sum(40)_{1…12}$ /12= 0.89 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.55 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 94.67 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	

Total = $Sum(44)_{1…12}$ = 1136.02 (44)

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)

(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	

Total = $Sum(45)_{1…12}$ = 1489.5 (45)

If instantaneous water heating 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)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		180	(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):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	180	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.01	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.87	(52)
Temperature factor from Table 2b		0.6	(53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0.97	(54)
Enter (50) or (54) in (55)		0.97	(55)

Water storage loss calculated 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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each 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 DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(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	

Output from water heater (annual)$_{1...12}$ | 2117.69 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.03	83.46	89.02	81.71	81.45	74.76	73.68	78.25	77.3	84.63	87.1	92.41	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	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)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 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)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see 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 fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 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 (Table 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 internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)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. Solar gains:

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

DER WorkSheet: New dwelling design stage

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

West	0.9x	0.77	x	7.2	x	92.28	x	0.63	x	0.1	=	29.01	(80)
West	0.9x	0.77	x	7.2	x	113.09	x	0.63	x	0.1	=	35.55	(80)
West	0.9x	0.77	x	7.2	x	115.77	x	0.63	x	0.1	=	36.39	(80)
West	0.9x	0.77	x	7.2	x	110.22	x	0.63	x	0.1	=	34.65	(80)
West	0.9x	0.77	x	7.2	x	94.68	x	0.63	x	0.1	=	29.76	(80)
West	0.9x	0.77	x	7.2	x	73.59	x	0.63	x	0.1	=	23.13	(80)
West	0.9x	0.77	x	7.2	x	45.59	x	0.63	x	0.1	=	14.33	(80)
West	0.9x	0.77	x	7.2	x	24.49	x	0.63	x	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	x	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	x	11.02	x	28.07	x	0.63	x	0.1	=	13.51	(81)
Northwest	0.9x	0.77	x	11.02	x	14.2	x	0.63	x	0.1	=	6.83	(81)
Northwest	0.9x	0.77	x	11.02	x	9.21	x	0.63	x	0.1	=	4.44	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.61	57.41	87.27	121.46	147.29	150.92	143.56	123.74	99.11	65.88	38.53	26.61	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	474.94	497.94	512.83	523.4	525.43	506.59	485.08	472.02	460	450.61	450.26	458.4	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.95	0.83	0.66	0.69	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.06	20.15	20.31	20.54	20.77	20.94	20.99	20.98	20.88	20.61	20.3	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.16	20.16	20.17	20.18	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.76	0.54	0.59	0.86	0.98	1	1	(89)

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

(90)m=	18.9	19.02	19.26	19.6	19.92	20.14	20.18	20.18	20.08	19.7	19.25	18.88	(90)

fLA = Living area ÷ (4) = | 0.3 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × 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)

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

(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)

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	1	0.99	0.98	0.93	0.78	0.58	0.62	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)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)
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=	1146.45	1106.35	997.96	828.7	638.15	430.01	284.63	298.65	465.16	705.61	942.96	1142.3	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	500.55	410.24	364.08	228.17	111.27	0	0	0	0	197.51	356.51	509.55	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2677.88 (98)

Space heating requirement in kWh/m²/year 31.62 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2677.88	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2677.88	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2117.69	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2117.69	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	47.96	(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)

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Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		191.68	(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) =	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 kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) 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	=	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) x		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) =				8.36	(384)
EI rating (section 14)					92.68	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 8

Address : 3 Bed Flat, 219-223 Coldharbour Lane, Loughborough Junction, LONDON

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.8	(1a)	x	2.5	(2a)	=	124.5	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.8	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			124.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (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)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	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 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 x (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) ÷ 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

Number of sides sheltered		3	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed 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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)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	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) 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. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.8	x	1/[1/(0.73)+ 0.04]	=	7.66			(27)
Windows Type 2			2.475	x	1/[1/(0.73)+ 0.04]	=	1.76			(27)
Walls Type1	19.5	10.8	8.7	x	0.15	=	1.31			(29)
Walls Type2	3.5	2.47	1.03	x	0.15	=	0.15			(29)
Total area of elements, m²			23							(31)
Party wall			51.75	x	0	=	0			(32)
Party floor			49.8							(32a)
Party ceiling			49.8							(32b)
Internal wall **			45.6							(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	10.87	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13269.55	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	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 used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		5.22	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	16.09	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	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 transfer coefficient, 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	

Average = Sum(39)$_{1…12}$ /12= 25.1 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (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

Average = Sum(40)$_{1…12}$ /12= 0.5 (40)

Number of days in month (Table 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. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	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	66.78	69.75	72.72	75.68	78.65	81.62

Total = Sum(44)$_{1…12}$ = 890.4 (44)

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)

(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

Total = Sum(45)$_{1…12}$ = 1167.46 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(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 180 (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): 1.85 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.11 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.11 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)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 cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix 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 (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(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)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each 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	134.67	130.75	141.52	140.67	156.56	163.76	174.89	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	178.71	157.95	166.91	151.05	149.06	134.67	130.75	141.52	140.67	156.56	163.76	174.89	

Output from water heater (annual)$_{1...12}$ 1846.5 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.38	76.87	82.46	76.32	76.52	70.87	70.43	74.02	72.86	79.02	80.54	85.11	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also 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)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	146.71	148.24	144.4	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(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. evaporation (negative values) (Table 5)													
(71)m=	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)
Water heating gains (Table 5)													
(72)m=	116.11	114.39	110.83	106	102.85	98.43	94.67	99.49	101.2	106.21	111.86	114.4	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	328.86	326.68	316.34	300.21	284.31	269.06	259.32	264.6	273.1	289.39	307.81	321.17	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	2.47	x	36.79	x	0.63	x	0.1	=	3.98	(77)
Southeast 0.9x	0.77	x	2.47	x	62.67	x	0.63	x	0.1	=	6.77	(77)
Southeast 0.9x	0.77	x	2.47	x	85.75	x	0.63	x	0.1	=	9.27	(77)
Southeast 0.9x	0.77	x	2.47	x	106.25	x	0.63	x	0.1	=	11.48	(77)
Southeast 0.9x	0.77	x	2.47	x	119.01	x	0.63	x	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	113.91	x	0.63	x	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	x	92.85	x	0.63	x	0.1	=	10.03	(77)
Southeast 0.9x	0.77	x	2.47	x	69.27	x	0.63	x	0.1	=	7.48	(77)
Southeast 0.9x	0.77	x	2.47	x	44.07	x	0.63	x	0.1	=	4.76	(77)
Southeast 0.9x	0.77	x	2.47	x	31.49	x	0.63	x	0.1	=	3.4	(77)
Southwest 0.9x	0.77	x	10.8	x	36.79		0.63	x	0.1	=	17.35	(79)
Southwest 0.9x	0.77	x	10.8	x	62.67		0.63	x	0.1	=	29.55	(79)
Southwest 0.9x	0.77	x	10.8	x	85.75		0.63	x	0.1	=	40.43	(79)
Southwest 0.9x	0.77	x	10.8	x	106.25		0.63	x	0.1	=	50.1	(79)
Southwest 0.9x	0.77	x	10.8	x	119.01		0.63	x	0.1	=	56.12	(79)
Southwest 0.9x	0.77	x	10.8	x	118.15		0.63	x	0.1	=	55.71	(79)
Southwest 0.9x	0.77	x	10.8	x	113.91		0.63	x	0.1	=	53.71	(79)
Southwest 0.9x	0.77	x	10.8	x	104.39		0.63	x	0.1	=	49.22	(79)
Southwest 0.9x	0.77	x	10.8	x	92.85		0.63	x	0.1	=	43.78	(79)
Southwest 0.9x	0.77	x	10.8	x	69.27		0.63	x	0.1	=	32.66	(79)
Southwest 0.9x	0.77	x	10.8	x	44.07		0.63	x	0.1	=	20.78	(79)
Southwest 0.9x	0.77	x	10.8	x	31.49		0.63	x	0.1	=	14.85	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(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	363	366.04	361.79	353.28	337.54	325.34	325.11	326.91	329.54	333.36	339.42	(84)

7. Mean internal temperature (heating season)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.96	0.91	0.81	0.66	0.47	0.33	0.35	0.52	0.77	0.93	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.81	20.86	20.92	20.98	21	21	21	21	21	20.99	20.91	20.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.51	20.51	20.51	20.52	20.52	20.53	20.53	20.53	20.52	20.52	20.52	20.51	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.9	0.79	0.62	0.43	0.3	0.31	0.49	0.74	0.92	0.97	(89)

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

(90)m=	20.26	20.33	20.42	20.5	20.52	20.53	20.53	20.53	20.52	20.51	20.41	20.25	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)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	(92)

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

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(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)

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=	0.97	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 (84)m													
(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)
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=	416.48	401.35	361.22	296.95	226.39	151.48	102.2	106.8	164.82	253.71	341.39	413.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	57.96	38.53	22.77	5.77	0.65	0	0	0	0	3.18	24.81	62.07	

Total per year (kWh/year) = $\mathrm{Sum}(98)_{1\ldots5,9\ldots12}$ =	215.73	(98)
Space heating requirement in kWh/m²/year	4.33	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		215.73	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	215.73	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1846.5	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1846.5	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.62	(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 outside		116.96	(330a)

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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

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
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	=	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 instantaneous 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 dwelling	(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 applicable						
Item 1		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)
EI rating (section 14)					97.41	(385)

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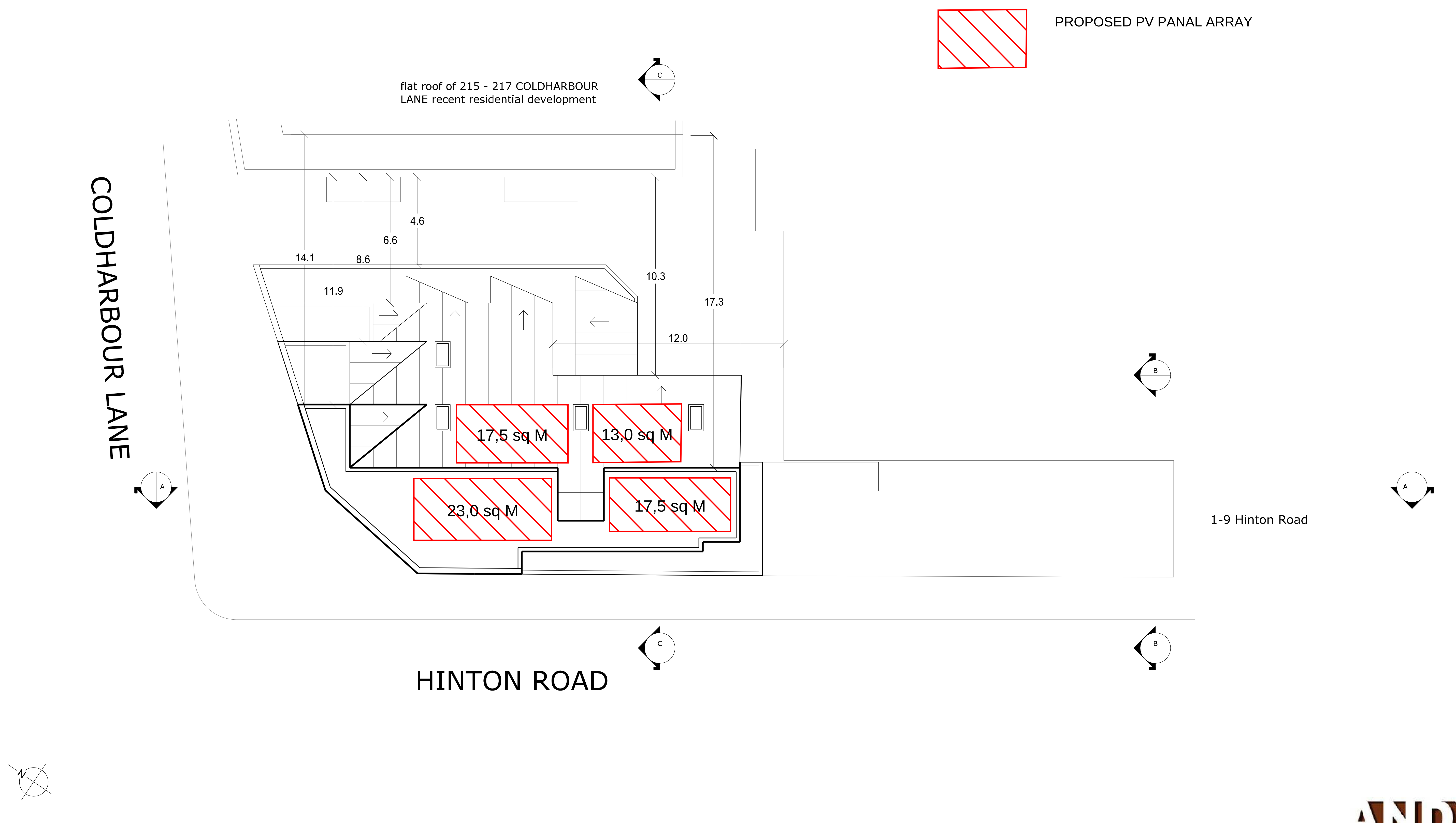
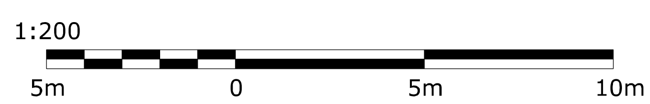
P5.08





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