Consulting Engineers

CLIENT:
Sudaj Ltd

Sustainability and Energy Statement

FOR THE PROPOSED

Residential Units

at

82 Guildford Street
Bloomsbury
London
WC1N 1DF

01 August 2014

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BSE 3D are a Building Services, Energy and Environmental, multi-disciplinary consultancy consisting of engineers, energy consultants, environmental experts, BREEAM assessors, BIM specialists and BREEAM accredited professionals.

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1. EXECUTIVE SUMMARY

This report has been prepared on behalf of Sudaj Ltd to present and summarise the work of the design team exploring the energy options and strategies for the proposed development of 4 residential units on the site currently known as 82 Guildford Street, Bloomsbury, London WC1N 1DF.

The proposed scheme is a reconfiguration of the existing building within the constraints of an existing listed building and whilst the target is to strive to achieve a BREEAM Domestic Refurbishment rating of Very Good, the team need to consider the building fabric and associated services and use best endeavours to achieve the best practical overall rating. Very Good may prove unachievable due to the limitations of the listed building.

The pre-assessment carried out for the development predicts a score of 51.55 credits, which does not quite achieve the required 55 credits for BREEAM Domestic Refurbishment 'Very Good'.

The chart on the following page provides a summary of the CO2 savings achieved by the proposed change of use over the development with existing building fabric and systems. The 19.72% reduction in CO2 emissions reflects regulated energy use only, in accordance with Part L Building Regulations. Unregulated energy use is not taken into account in the calculation of BREEAM credits (e.g. plug-in load and appliances).

The number of credits obtained in the BREEAM pre- assessment reflects the client and design team's aspirations in incorporating as many sustainability measures as possible.

ENERGY STATEMENT

The figures below are based on SAP calculations carried out on the basement, ground floor and third floor. These calculations are provided in the appendix to this document.

	CO2 Emissions/m2	% reduction over baseline
Baseline scenario	1.01	
Baseline + energy efficiency	0.99	1.76
Baseline + energy efficiency + efficient services	0.79	19.72

The total 19.72% improvement over the baseline for the improved envelope is calculated using the methods given in BREEAM Domestic Refurbishment. The actual reduction in carbon emissions is much greater than this. (see page 13 section 2.2 for an explanation of this)

Measures suggested by Camden Council for listed buildings and how they have been incorporated.

A range of thermal efficiency measures can be implemented, which avoid harm to the historic environment. Ranked according to their impact on heritage and the technical risks, these include:

1. **Ensure that the building is in a good state of repair**.

The building will be thoroughly refurbished with a new roof, windows and doors. Approximately 35% of the project cost will be spent on improvements to energy efficiency.

2. Minor interventions - upgrade the easier and non-contentious elements:

- **Insulate roof spaces and suspended floors;**

  This is to be carried out to achieve a u-value of 0.15W/m2K for both roof and floor.

- **Provide flue dampers - (close in winter, open in summer);**

  All existing chimneys are to be sealed.

- **Use curtains, blinds and window shutters;**

  Curtains and blinds to be fitted.

- **Provide energy efficient lighting and appliances;**

  Energy efficient lighting and appliances will be provided.

- **Draught-seal doors and windows**;

  New windows and doors to be provided with full draught stripping.

- **Provide hot water tank and pipe insulation.**

  There will be no hot water tanks. Pipes will be insulated.

3**. Moderate interventions - upgrade vulnerable elements:**

- **install secondary (or double) glazing (if practicable**);

  Secondary glazing to be fitted to the front elevation (subject to permission being given) and highly efficient double glazing to the rear.

4. Upgrade building services and give advice to building users on managing them efficiently:

- **Install high-efficiency boiler and heating controls;**

  Gas boilers of 90% efficiency to be installed with weather compensation boiler interlock and TRV's.

- **Install smart metering;**

  Smart metering to water, gas and electricity will be installed.

- **Install solar panels, where not visible from the street or public spaces.**

  In this case there is no suitable position for solar technologies. There is only a very small inward sloping roof. Roof windows have been chosen over solar technologies to provide natural daylight to the top floor flat.

5. Major interventions - upgrade more difficult and contentious elements (where impact on heritage values and level of technical risk shown to be acceptable) provide solid wall insulation.

Solid wall insulation is to be provided. 200mm of fibreboard is to be used to the front and rear of the existing solid walls with lime plaster to maintain 'breathability. The new walls to the rear will be blockwork with external wall insulation. All external walls to achieve a u-value of 0.17W/m2K.

2. INTRODUCTION

2.1 Proposed development

82 Guilford Street is located along Guilford Street, in a close proximity to Russell Square underground station, within the London Borough of Camden. The proposed development includes the refurbishment of an existing Grade II Listed Building. The site lies within walking distance of shops and services in town centre.

The approximate site location is shown in the figure below.

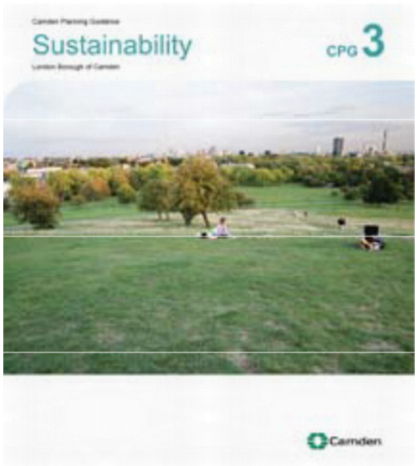
2.2 Camden Council Sustainability Requirements and Policies

2.2.1 Camden Council – Planning Guidance Existing Buildings

The Camden Planning Guidance support the policies set out in the Local Development Framework (LDF). While the Camden LDF contains policies relating to sustainability in their Core Strategy and Development Policies documents, the Council also has a separate planning guidance specific to sustainability.

According to the Camden Council,

- All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included. As a guide, at least 10% of the project cost should be spent on the improvements.
- Where retro-fitting measures are not identified at application stage we will most likely secure the implementation of environmental improvements by way of condition. Appendix 1 sets out a checklist of retro fit improvements for applicants.
- Development involving a change of use or a conversion of 5 or more dwellings or 500sq m of any floor space, will be expected to achieve 60% of the un-weighted credits in the Energy category in their EcoHomes or BREEAM assessment, whichever is applicable. (See the section on Sustainability assessment tools for more details).
- Special consideration will be given to buildings that are protected e.g. listed buildings to ensure that their historic and architectural features are preserved.



The sections that will be covered the Sustainability Statement listed below:

- The energy hierarchy
- Energy efficiency: new buildings
- Decentralised energy networks and combined
- heat and power
- Renewable Energy
- Water Efficiency
- Sustainable use of materials
- Sustainability assessment tools
- Brown roofs, green roofs and green walls
- Flooding
- Adapting to climate change
- Biodiversity

2.2.2 The London Plan

The London Plan 2011 requires compliance with the following policies relating to climate change:

- Policy 5.2 Minimising Carbon Dioxide Emissions (refer to the supplementary Energy Report)
- Policy 5.3 Sustainable Design and Construction
- Policy 5.5 Decentralised Energy Networks (refer to the supplementary Energy Report)
- Policy 5.6 Decentralised Energy in Development Proposals (refer to the supplementary Energy Report)
- Policy 5.7 Renewable Energy (refer to the supplementary Energy Report for more details)
- Policy 5.9 Overheating and Cooling
- Policy 5.10 Urban Greening
- Policy 5.11 Green Roofs
- Policy 5.12 Flood Risk Management
- Policy 5.13 Sustainable Drainage
- Policy 5.15 Water use and Supplies
- Policy 5.16 Waste Self-Sufficiency
- Policy 5.18 Construction. Excavation and Demolition Waste
- Policy 5.19 Hazardous Waste
- Policy 5.20 Aggregates

Where possible, the London Plan policies have been met through the implementation of the BREEAM Domestic Refurbishment.

2.2.3 Historic and Listed Buildings

The refurbishment of this building has been planned according to the guidance given on Camden Councils website:

A range of thermal efficiency measures can then be implemented, which avoid harm to the historic environment. Ranked according to their impact on heritage and the technical risks, these include:

1. Ensure that the building is in a good state of repair
2. Minor interventions - upgrade the easier and non-contentious elements:
- *insulate roof spaces and suspended floors;*
- *provide flue dampers - (close in winter, open in summer);*
- *use curtains, blinds and window shutters;*
- *provide energy efficient lighting and appliances*
- *draught-seal doors and windows;*
- *provide hot water tank and pipe insulation.*

3. Moderate interventions - upgrade vulnerable elements:
- *install secondary (or double) glazing (if practicable);*

4. Upgrade building services and give advice to building users on managing them efficiently:
- *install high-efficiency boiler and heating controls;*
- *install smart metering;*

- *install solar panels, where not visible from the street or public spaces.*

5. Major interventions - upgrade more difficult and contentious elements (where impact on heritage values and level of technical risk shown to be acceptable)

- *provide solid wall insulation.*

2.2.4 BREEAM Domestic Refurbishment Pre- Assessment

BREEAM Domestic Refurbishment is a performance based assessment method and certification scheme for domestic buildings undergoing refurbishment, providing an authoritative rating for refurbished homes, covering houses, flats and apartments. It also recognises limitations of existing buildings including their inherent built form and location. Since June 2012, BREEAM Domestic Refurbishment has superseded the EcoHomes assessment method.

BREEAM Domestic Refurbishment measures the sustainability of a development against design categories, rating the entire development as a complete package. Each standard requires developments to gain credits by meeting sustainable design principles over seven key areas:

1. Management
2. Health and Wellbeing
3. Energy
4. Water
5. Materials
6. Waste
7. Pollution

Camden Council sets Ecohomes 'Excellent' rating for refurbishments and conversions as a requirement from 2013. However, since Ecohomes was superseded by BREEAM Domestic Refurbishment in 2012, the development at 82 Guilford Street aims to reach BREEAM Domestic Refurbishment 'Excellent', reflecting the design team's aspirations in incorporating appropriate sustainability measures. The following section outlines the measures to be adopted at 82 Guilford Street to achieve BREEAM Domestic Refurbishment 'Excellent'.

3. PASSIVE AND ENERGY EFFICIENT DESIGN STRATEGIES

3.1 Building form and design

The building is listed and therefore there are restrictions on what changes can be made. The building form and front elevation must remain unchanged.

3.2 Building Fabric Performance

U-values are to be improved where this is permitted.

- **Existing walls** will be improved to 0.17W/m2K (from approximately 2.1w/m2K). Internal wall insulation is permitted within the restriction of the listed building to existing walls. This must be a natural insulation to maintain the 'breathability of the solid walls'. 200mm of fibreboard will be used in this case together with lime plaster to prevent any problems with condensation and mould growth. **New walls** to the rear will achieve a u-value of 0.17W/m2K using externally insulated blockwork.
- **Windows** to the front elevation will be retained, refurbished and draught stripped, with secondary glazing added. Windows to the rear will have new high efficiency double glazing of u-value 1.2W/m2K.
- **Roof and external floors** are to be improved to u-value 0.15W/m2K

	U-value	U-value
Fabric Element	**Part L1B 2010**	**Proposed Refurbished Building**
External Wall	0.28	0.17
Exposed Floor	0.22	0.15
Exposed Roof	0.18	0.15
External Glazing	1.6	Secondary glazing 2.4, new windows to rear 1.2

Table 1 Building Fabric Standards in Guildford Street Development

The u-values which inform the BREEAM Domestic Refurbishment assessment prior to development are the backstop values given in Part L 2013 which are in fact much greater than those of the existing building. For example the wall u-value that needs to be used prior to development in the SAP calculation is 0.28, whereas in actual fact it was 2.1W/m2K this means that the actual energy and carbon savings of the refurbishment of this building will be much greater than those shown.

3.2.1 Air permeability and Thermal Bridging

The building refurbishment has been carefully designed to improve airtightness and thermal bridge-free detailing is also given priority. The calculations are based on an airtightness of 10m3/m2/hr.

It is expected that a better value than this can be achieved in practice.

3.2.2 Limiting solar gain in summer

Blinds will be fitted to the front elevation of this building to limit solar gain.

3.3 Efficient Building Services

3.3.1 Principles

The policies on energy have been considered thoroughly throughout the pre-planning design. The approach to achieving the planning policy energy objectives has been to adopt the Mayor's Energy and Heating Hierarchies, and to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The energy strategy for the scheme follows the energy hierarchy:

- Using less energy by passive design and energy efficiency measures
- Supplying energy efficiently by means of highly efficient gas combi boilers
- In this case renewable energy is not appropriate

3.3.2 Heating, Ventilation and Cooling

A simple low carbon heating strategy has been designed.

- Natural ventilation with fans to bathrooms and kitchens
- High efficiency individual gas combi boilers
- Radiators
- Local, efficient, simple but effective controls are provided for the units. Local controls will be provided to connect to the room temperature sensors. A weather compensated system will be provided for the heating system.

Each dwelling will be provided with their own gas, water and electricity meters for individual metering and billing.

3.3.3 Domestic Hot & Cold Water

This will be provided by gas combi boilers.

3.3.4 Lighting

The lighting to each of the apartments will be provided by at least 80% low energy fittings. In addition external lighting will be energy efficient with daylight cut-off

3.3.5 Enhanced User Understanding and Controls

Ensuring that building users understand how the building works is crucial to limiting energy consumption. Engineering the building to operate autonomously and making it simple to use and operate further helps reduce consumption. The team will work closely to ensure the final building solution is understandable and manageable by the users.

3.3.6 Smart Metering

Smart meters will be provided to each flat to show consumption data for electricity, water and gas. This is required to achieve credits in the BREEAM Domestic Refurbishment assessment and aims to assist the occupants in minimising their consumption.

4. LOW AND ZERO CARBON TECHNOLOGIES

To reduce the carbon emission of the buildings, the first step has been to adopt a passive design whereby the architectural design of the building, including fabric specification and engineering services help in minimising the energy demand of the building.

To further help reduce the carbon emissions from the building we can look to the installation of Low and Zero Carbon technologies. Careful consideration and calculation of these options can help in reducing energy consumption and carbon emission of the buildings over time to realise an economical benefit for the building owner / occupier.

Therefore this part of the report investigates the feasibility of installing different low/zero carbon technologies that could be considered appropriate for the area. The technologies considered in this report include:

- Air source heat pumps
- Solar thermal energy capture
- Photovoltaic Panels

It is important to consider the use of renewable technologies however in this case it is thought to be inappropriate to include any for the reasons outlined below.

5. AIR SOURCE HEAT PUMPS

5.1 Technology explained:

Air source heat pumps use similar principles as ground source heat pumps. The principle of the heat pump, is to take low-grade energy from the surrounding air by means of a fan pulling the outside air through a heat exchanger at a lower temperature to pick up heat in the refrigerant cycle. The compressor within the refrigerant cycle then compresses the refrigerant gas increasing the temperature concurrently. The heat is then removed for heating and the whole process continues.

Unlike the ground source heat pumps where the temperature of ground is relatively stable throughout the year, in air source heat pumps the temperature can be highly variable in accordance with the weather. In the past, to run the system most efficiently, it is sometimes best to combine the system with another system such as conventional boilers or a CHP machine to run when the air temperature is very low and the coefficient of performance (COP) of ASHP is lower. However, more efficient machines and refrigerants are now available that mean higher COP's during colder ambient temperatures thus removing the necessity for combining with traditional boilers to further save infrastructure charges.

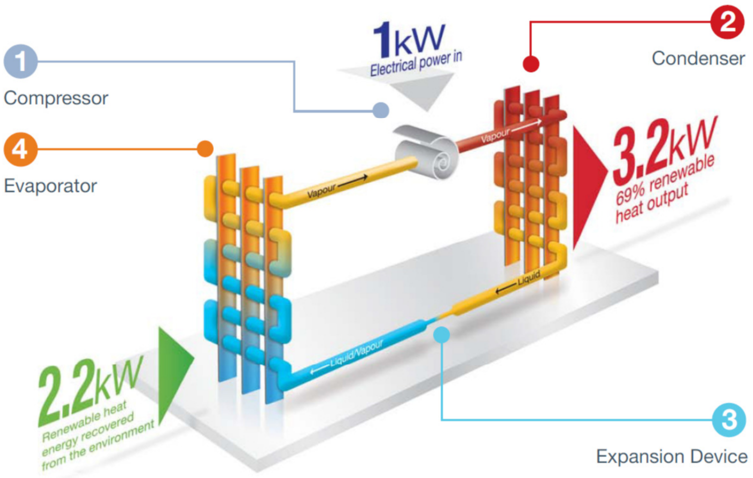


Figure 13 - Air Source Heat Pump principles

5.2 Potentials for Guildford Street Development

5.2.1 Natural Resources

System uses ambient air as the renewable energy source and using electricity –converts low grade heat to higher grade heat.

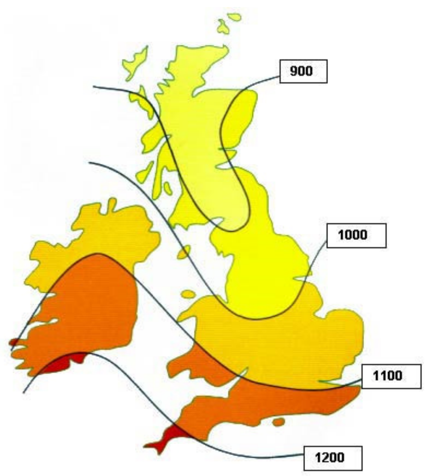
5.2.2 Technical feasibility

This technology cannot be easily installed to this building as there is not a suitable position which would be acceptable to the occupants and noise from the compressors, pumps and fans would be unacceptable in such a tight site.

6. SOLAR THERMAL ENERGY

6.1 Technology explained:

Solar collectors absorb the solar radiation and sun's energy and provide heating and hot water. There are two basic types of solar heating systems, liquid based system or air based system. Liquid based systems are usually used with storage which makes the solar thermal system more viable, matching the demand with the availability of hot water. The circulation of heat can be passive (relying on water pressure) or active (using pumps). The two most common types of solar collectors are flat plate and evacuated tube collectors. Evacuated tubes are more sophisticated, more efficient and also more expensive than flat panels.

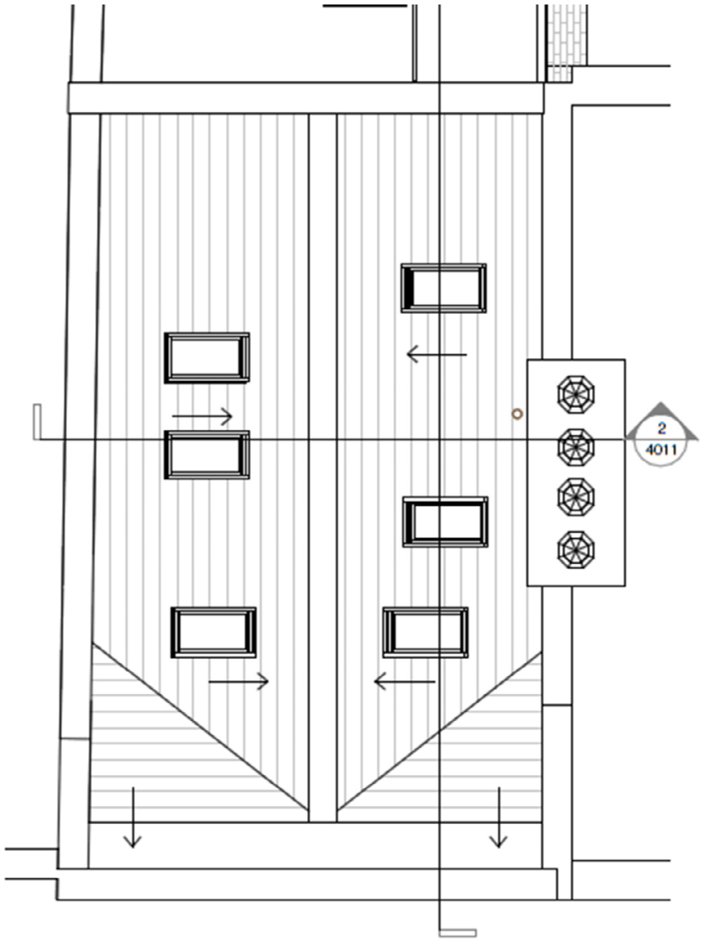


6.2 Potential for Guilford Street Development

6.2.1 Natural Resources

The peak solar radiation in London is just less than 1 kW/m^2. The best location for solar thermal panels are on building roofs or walls, facing south (within 15°).

6.2.2 Technical feasibility



04 General Arrangement - Roof Plan
1 : 50

The roof plan provided shows how roof windows have been incorporated into the top floor flat to improve the daylighting and thus the need for electric lighting. This does not leave sufficient space for the installation of solar technologies on this small inward sloping roof.

7. PHOTOVOLTAIC (PV) PANELS

7.1 Technology explained:

Photovoltaic systems use solar cells to convert sunlight into electricity. The PV cell consists of semi-conducting material usually silicon. It creates an electric field when light shines on the cell which causes electricity to flow. There are different kinds of PV panels on the market today, thin films, polycrystalline and monocrystalline. These have different efficiencies normally ranging from 12-28%.

PV panels can be integrated with the fabric of the building. In ideal circumstances the modules replace building components such as curtain walls, roof tiles, atria and structural glazing and vertical walls. Framed PV modules can either be roof mounted or free standing.

7.2 Potentials for Guilford Street Development

7.2.1 Natural Resources

The annual isolation is reasonably good in this area.

7.2.2 Technical feasibility

As outlined previously for solar water heating there is not sufficient roof space to install solar photovoltaics.

8. BREEAM DOMESTIC REFURBISHMENT

8.1 Management

MAN 1 Home User Guide
A 'Home User Guide' will be made available to the dwelling providing occupants with an understanding of the energy associated with the operation of their home. This non-technical guide will include operational instructions, recommendations on improving energy use and information on the surrounding area (local amenities) to obtain full credits in this section.

MAN 2 Responsible Construction Practices
The tender specification will require contractors to be compliant with the Considerate Constructors Scheme (CCS). It is expected that formal certification will be achieved and that contractors will operate beyond compliance level (CCS Code of Considerate Practice score between 35 and 40 with score 7 in each section).

MAN 3 Construction Site Impacts
To minimise the construction impacts of the site, contractors will be required to monitor, report and set targets for the production of CO2 arising from site activities in respect to energy use and water consumption.

MAN 4 Security
All external doors and accessible windows will meet minimum BREEAM standards and be appropriately fitted.

An Architectural Liaison Officer will be consulted and their advice will be incorporated into the design of the development in accordance with 'Secured By Design' standards.

The requirement is for putty (where present) to be on the inside of windows for security. However this is not possible in the case of the existing windows. In this case negotiation with the ALO is required to ensure security is achieved within the restrictions of the list building status.

MAN 5 Protection and Enhancement of Ecological Features
The development is currently located on a site with low ecological value as there are no existing features of ecological value at the site. Therefore, this credit can be awarded by default.

MAN 6 Project Management
A project implementation plan will be compiled by the project manager; individual and shared responsibilities will be assigned amongst the project team during an initiation meeting.

8.2 Health and Wellbeing

HEA 1 Daylighting
These credits are unlikely to be achievable as the size of the windows cannot be changed.

HEA 2 Sound Insulation
Building elements will be designed to meet Building Regulations Part E.

HEA 5 Ventilation
A minimum level of background ventilation will be provided (e.g. trickle ventilators) for all habitable rooms, kitchens, utility rooms and bathrooms compliant with section 7, Part F, 2010. Extract ventilation will be provided in all wet rooms (e.g. kitchen, utility and bathrooms), and will be compliant with section 5, Building Regulations Approved Document Part F 2010. In addition, purge ventilation will be provided in all habitable rooms and wet rooms in compliance with section 7, Building Regulations Approved Document Part F, 2010.

The refurbishment will be designed to meet the requirements of Building Regulations Part F section 3.11–3.16.

HEA 6 Safety
Smoke and carbon monoxide detection systems will be installed as part of the refurbishment. A compliant fire detection and alarm system will also be provided Energy

8.3 Energy

ENE 1 Improvement in Energy Efficiency Rating (EER)
The Energy Efficiency Rating (EER) is a measure of the overall efficiency of a dwelling. It accounts for regulated energy use in terms of heating, hot water, equipment, lighting and auxiliary energy use.

The methodology set out by the Department of Energy and Climate Change (DECC) for assessing the energy use of dwellings is the Standard Assessment Procedure (SAP). The version of SAP used for BREEAM Domestic Refurbishment is SAP 2009.

Preliminary SAP calculations have been carried out to assess the potential CO2 savings achieved through

- energy efficiency measures
- the efficient supply of energy

The average reduction in the EER for this development is calculated to be 4.33. This is not sufficient to achieve credits.

ENE 2 Energy Efficiency Rating (EER) Post Refurbishment
The reduction in energy demand of the proposed development has been outlined previously in this report. The SAP calculations show that and average of 3 credits can be achieved here.

ENE 3 Primary Energy Demand
An average primary energy demand of 153.94 kWh/m2/year will be achieved by the building post refurbishment. This achieves 6 credits.

ENE 5 Energy Labelled White Goods
All residential units in 82 Guilford Street will be supplied with an EU Energy Efficiency Labelling Scheme Leaflet, which provides guidance on the purchase of energy efficient white goods.

The dwellings will also be supplied with energy efficient white goods which meet the following standard:

- Fridges and freezers or fridge freezers, washing machines and dishwashers - Energy Saving Trust recommended appliances
- Tumble dryers or washer dryers - B rating under EU Energy Efficiency

ENE 6 Drying Space
The proposed development will include provisions for internal clothes drying, thereby reducing the amount of electricity consumed through the use of tumble dryers. Each 1-2 bedroom dwelling will include at least 4m of retractable drying lines, while a minimum of 6m will be provided in dwellings of 3 bedrooms, all within well-ventilated bathrooms.

ENE7 Lighting
Internal - When daylight is inadequate, lighting will be designed to give occupants flexibility in achieving desired illuminance levels without excessive energy use. The design will aim to achieve a maximum average wattage of 9 watts/m2 across the total floor area of the dwelling.

External - Energy efficient light fittings will be installed in the external spaces. In addition, external lights will be fitted with controls to reduce the energy consumption of the building during periods of infrequent use:

ENE 8 Energy Display Devices
Energy display devices will be installed in all flats to enable the occupants to gain an understanding of their energy consumption and to enable them to reduce their energy use in the future. The display devices will provide information on current electricity and primary heating consumption data.

ENE 8 Cycle Storage
Cycle spaces will be provided within the development to reduce the frequency of short car journeys. The cycle storage will be adequately sized, secure and accessible to all occupants, thereby achieving a credit in this category.

The provision of bicycle storage will be at a rate of 1 space for every flat.

8.4 Water

WAT 1 Internal Water Use
The water category aims to reduce the consumption of potable water in the home from all sources. These are mandatory credits within BREEAM Domestic Refurbishment, with BREEAM ‘Excellent’ setting an upper limit of 117 litres per person per day.

The development at 82 Guilford Street aims to reduce water consumption through the use of water efficient fittings, including dual flush toilet, water efficient shower heads and taps. The average capacity and maximum flow rates of the water fittings are listed below.

It is estimated that the proposed development will achieve a water consumption rate of 104.6 litres/ person/day.

WAT 2 External Water Use
Flat with a private garden will be equipped with a compliant rainwater collection system for external/ internal irrigation use. The volume of a rainwater butt for a 1-2 bedroom home with a private garden should be 150 litres.

Flats without garden space, as well as flats that only have balconies provided, achieve this credit by default.

WAT 3 Water meter
Water meters providing visual display of mains potable water consumption installed at a secure and visible location within all flats. The water meters will be capable of recording and displaying historical water consumption, and allowing occupants to monitor their water consumption over time. The meter will also be able to display current consumption either instantaneously or at half hourly intervals.

Fitting	Residential Units	
	Average capacity/Flow rate	Consumption (l/person/day)
WC (full flush)	6 litres per flush	17.64
WC (half flush)	3 litres per flush	
Kitchen and utility sink taps	6 litres per min	13
Wash basin tap	4 litres per min	7.9
Bath	180L capacity to overflow	19.8
Shower	8 litres per min	34.96
Washing machine	8.17L per kg (dry load)	17.16
Dishwasher	1.25L per place setting	4.5
Net internal water consumption		114.96
Normalisation factor		0.91
Total Water Use		**104.6**

Estimated Water Consumption

8.5 Materials

MAT 1 Environmental Impact of Materials
Embodied energy is the energy that is used in the manufacture, processing and the transportation of the materials to site.

The construction build-ups for each of the main building elements are rated from A+ to E. Each element to be used in the building has been rated according to the BRE Green Guide to Specification whereby:
A+ rated elements are least likely to affect the environment
E rated elements are most likely to affect the environment

It is assumed that most of the main building elements within this development will achieve between an A+ to C rating.

MAT 2 & MAT 3 Responsible Sourcing of Materials and Insulation
At least 80% of the materials specified will be obtained from legally and responsible sources. This includes all basic building elements, comprising the building frame, floors, roof, external walls, foundations and internal walls and all finishing elements.

In addition, 100% of all timber used on site will be legally sourced, thereby satisfying the mandatory requirements set out in this category. Any timber used in the structural and finishing elements will be specified from certified sustainable sources such as FSC or PEFC.

Where possible, on-site materials will be reused and recycled to lower transport CO2 emissions associated with off-site recycling. Where practicable, materials with a high recycled or waste content will be specified.

The insulation index for all new insulation used in external walls, ground floor, roof and building services will be less than 2 when calculated using the BREEAM Mat3 Insulation Calculator..

8.6 Waste

WAS 1 Household Waste
Non-recyclable: External space will be allocated for non-recyclable household waste, this will be collected by the Local Authority
Recyclable: A Local Authority Collection Scheme is in operation for the collection of recyclable household waste. Each dwelling will be provided with a bin, with a total capacity of 30 litres and to be located in a dedicated position in the kitchen.

WAS 2 Construction Site Waste Management
The development will minimise the impact of construction waste on the environment through a Site Waste Management Plan (SWMP). This plan will include:

- benchmarks for resource efficiency
- procedures and commitments to reduce hazardous and non-hazardous waste
- monitoring hazardous and non-hazardous waste

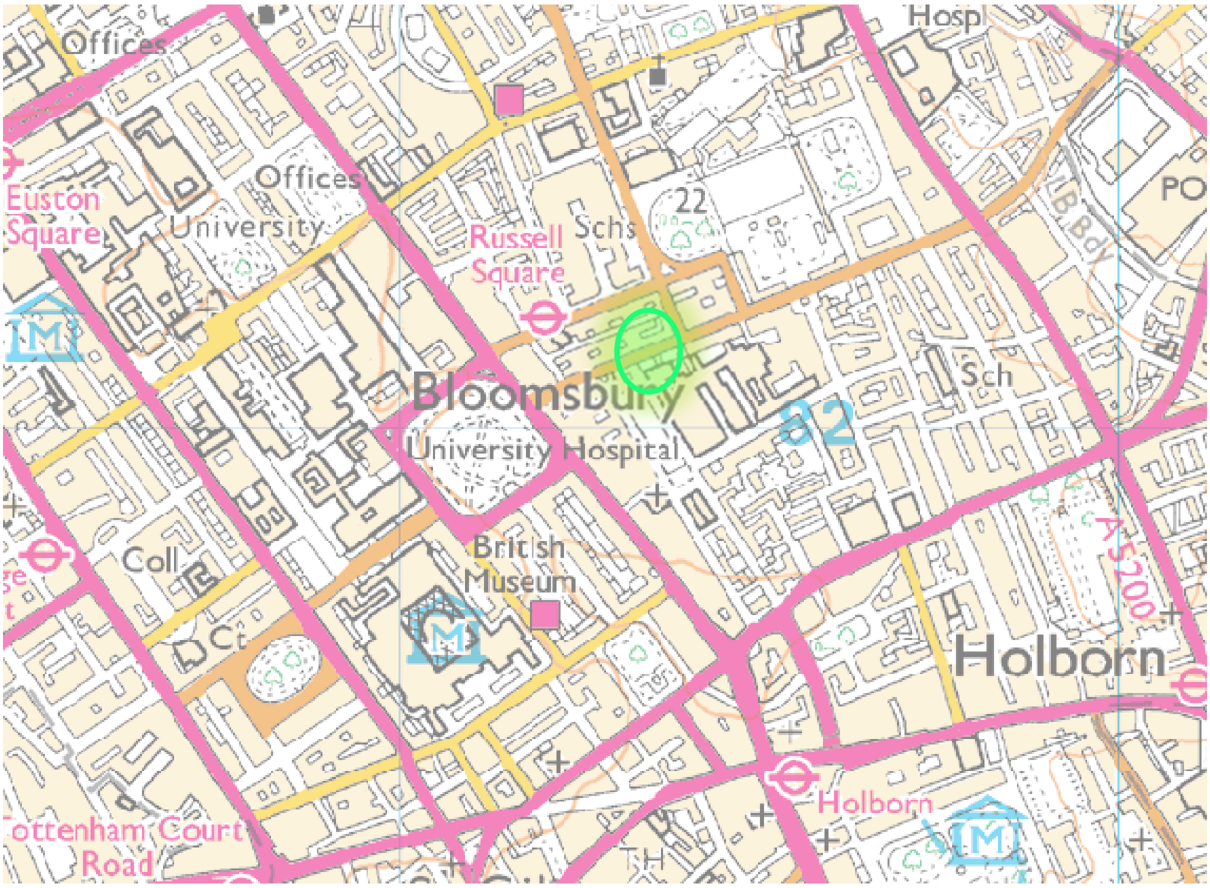
All waste generated through the refurbishment process will be managed in accordance with BREEAM recommendations.

A pre-refurbishment audit of the existing building, which covers demolition materials, will be completed. Non-hazardous demolition waste generated by the dwellings refurbishment will meet or exceed the refurbishment and demolition waste diversion benchmarks.

8.7 Pollution

POL1 NOx Emissions
This section aims to reduce the release of nitrogen oxide (NOx) into the atmosphere. Space heating and hot water requirements will be met by high efficiency gas combi boilers with low inherent NOx emissions. Gas boilers with NOx emissions of less than 70 mg/kWh will be specified.

POL3 Flooding
The Environment Agency flood map (as below) shows the site to be at low risk of flooding, however this credit is not achievable without a full flood risk assessment.



Flooding from rivers or sea without defences
Extent of Extreme flood
Areas benefiting from flood defences

Approximate Site Location

9. CONCLUSION

A number of steps have been considered and will continue to be considered to reduce the energy consumption and to provide a percentage of renewable energy for the proposed refurbishment.

9.1 BREEAM Domestic Refurbishment Pre- Assessment Results

A BREEAM Domestic Refurbishment pre- assessment was carried out for the 82 Guilford Street refurbishment, using the targets set by the client and project team. This reflects the client's and project team's commitment in adopting a range of sustainability measures over the life-cycle of the development.

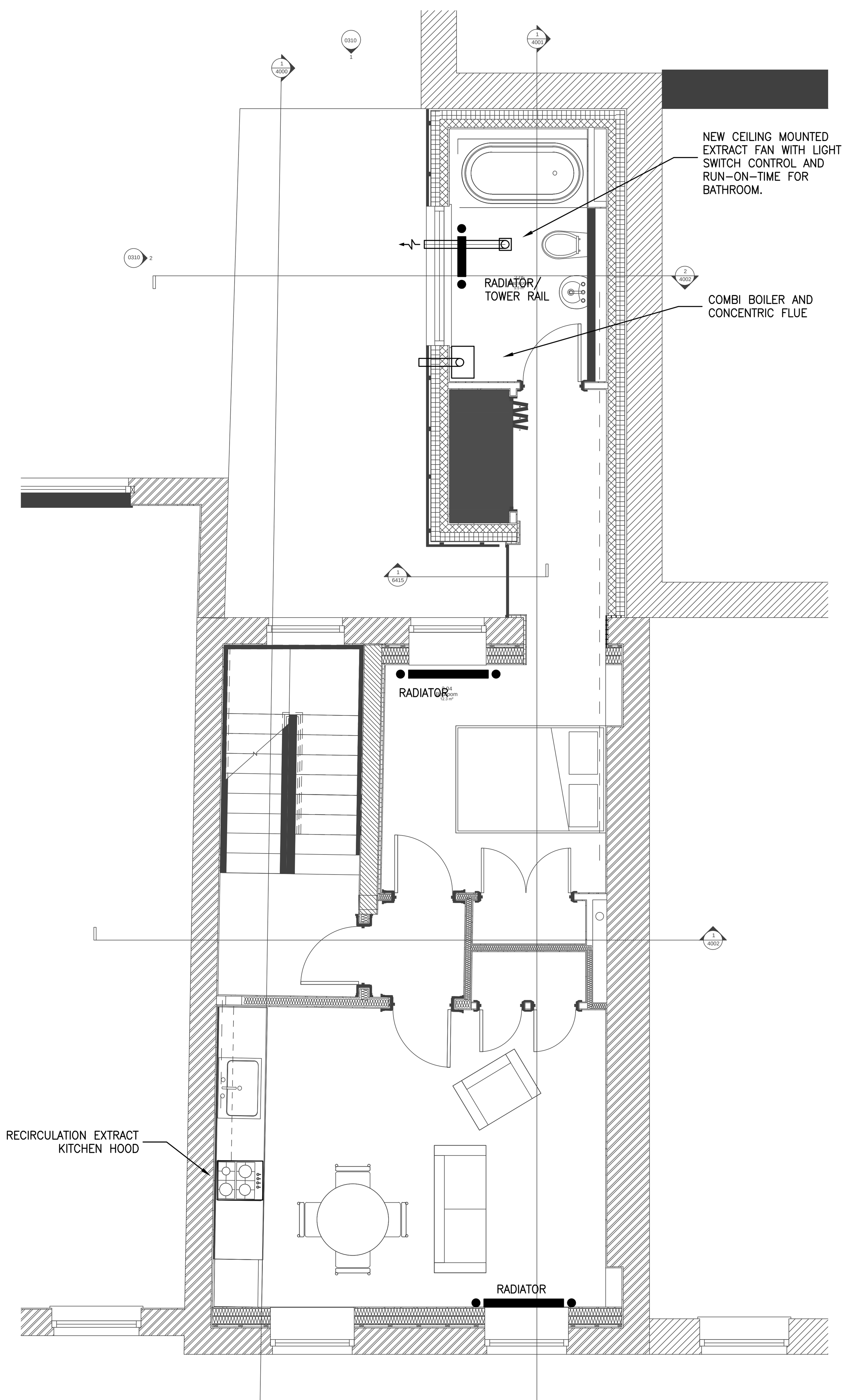
The table below summarises the number of credits achieved in each of the BREEAM categories, using the BRE Pre-Assessment Estimator.

The proposed development achieves a total of 51.55 credits, which exceeds the requirement for BREEAM 'Good'.

				Score Assessment		
		Credit Score	Credits Available	Sub Total	Weighting Factor	Points Score
Management	MAN 1 Home User Guide	3	3	6	12%	6.00
	MAN 2 Responsible Construction Practices	0	2			
	MAN 3 Construction Site Impacts	1	1			
	MAN 4 Security	0	2			
	MAN 5 Protection & Enhancement of Ecological Features	1	1			
	MAN 6 Project Management	1	2			
Health & Wellbeing	HEA 1 Daylighting	0	2	5	17%	7.08
	HEA 2 Sound Insulation	2	4			
	HEA 3 Volatile Organic Compounds	1	1			
	HEA 4 Inclusive Design	0	2			
	HEA 5 Ventilation	1	2			
	HEA 6 Safety	1	1			
Energy	ENE 1 Improvement in Energy Efficiency Rating	0	6	16	43%	23.72
	ENE 2 Energy Efficiency Rating Post Refurbishment	3	4			
	ENE 3 Primary Energy Demand	6	7			
	ENE 4 Renewable Technologies	0	2			
	ENE 5 Energy Labelled White Goods	1	2			
	ENE 6 Drying Space	1	1			
	ENE 7 Lighting	2	2			
	ENE 8 Display Energy Devices	2	2			
	ENE 9 Cycle Storage	1	2			
	ENE 10 Home Office	0	1			
Water	WAT 1 Internal Water Use	1	3	3	11%	6.60
	WAT 2 External Water Use	1	1			
	WAT 3 Water Meter	1	1			
Materials	MAT 1 Environmental Impact of Materials	6	25	14	8%	2.49
	MAT 2 Responsible Sourcing	4	12			
	MAT 3 Insulation	4	8			
Waste	WAS 1 Household Waste	2	2	4	3%	2.40
	WAS 2 Refurbishment Site Waste Management	2	3			
Pollution	POL 1 NOx Emissions	2	3	3	6%	2.25
	POL 2 Surface Water Runoff	1	3			
	POL 3 Flooding	0	2			
Innovation	MAN 6 Early Design Input	1	1	1	10%	1.00
	Level Achieved:	**Good**		**Total Point Scored:**		**51.55%**

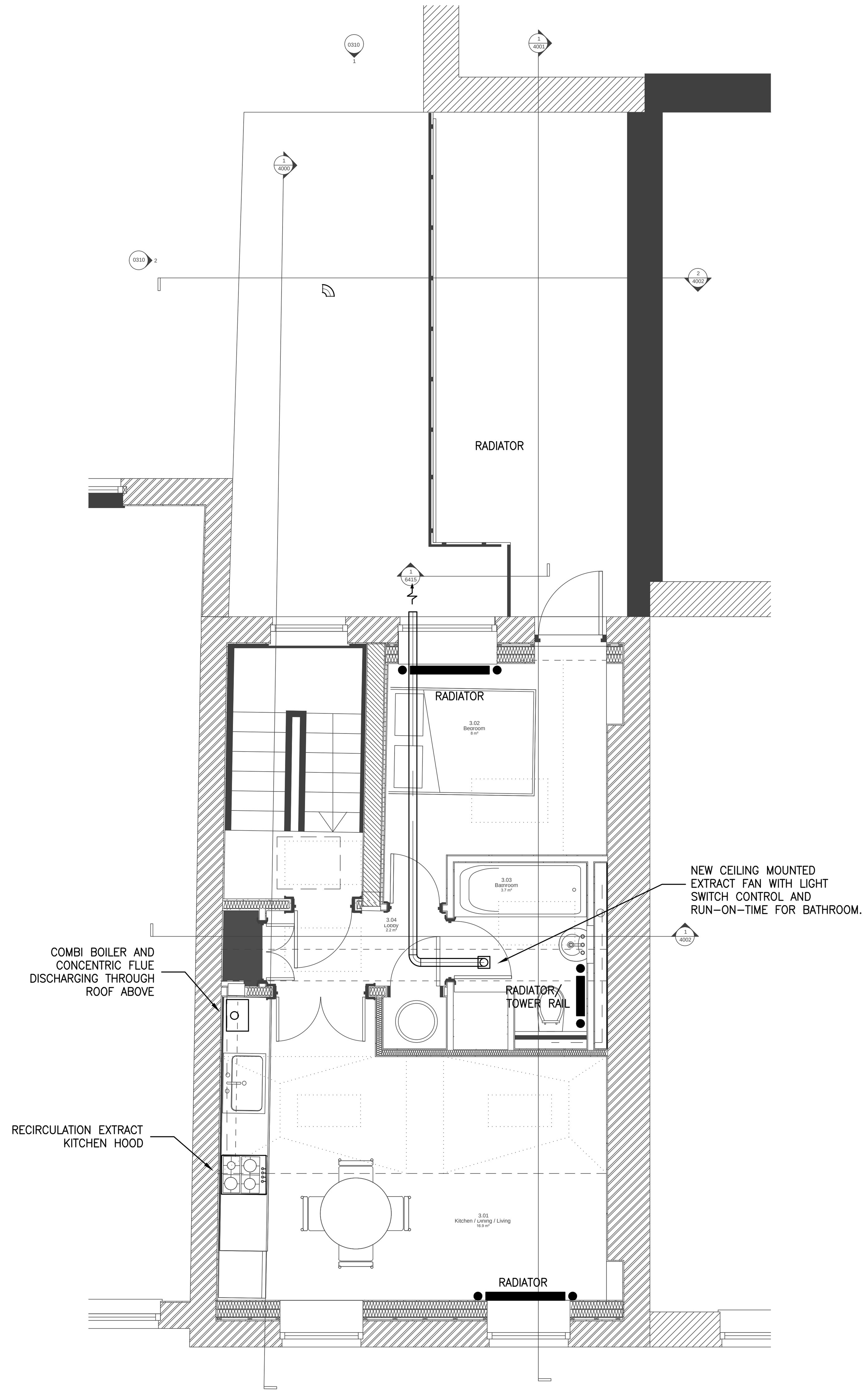
Appendix A

Outline Design Drawings



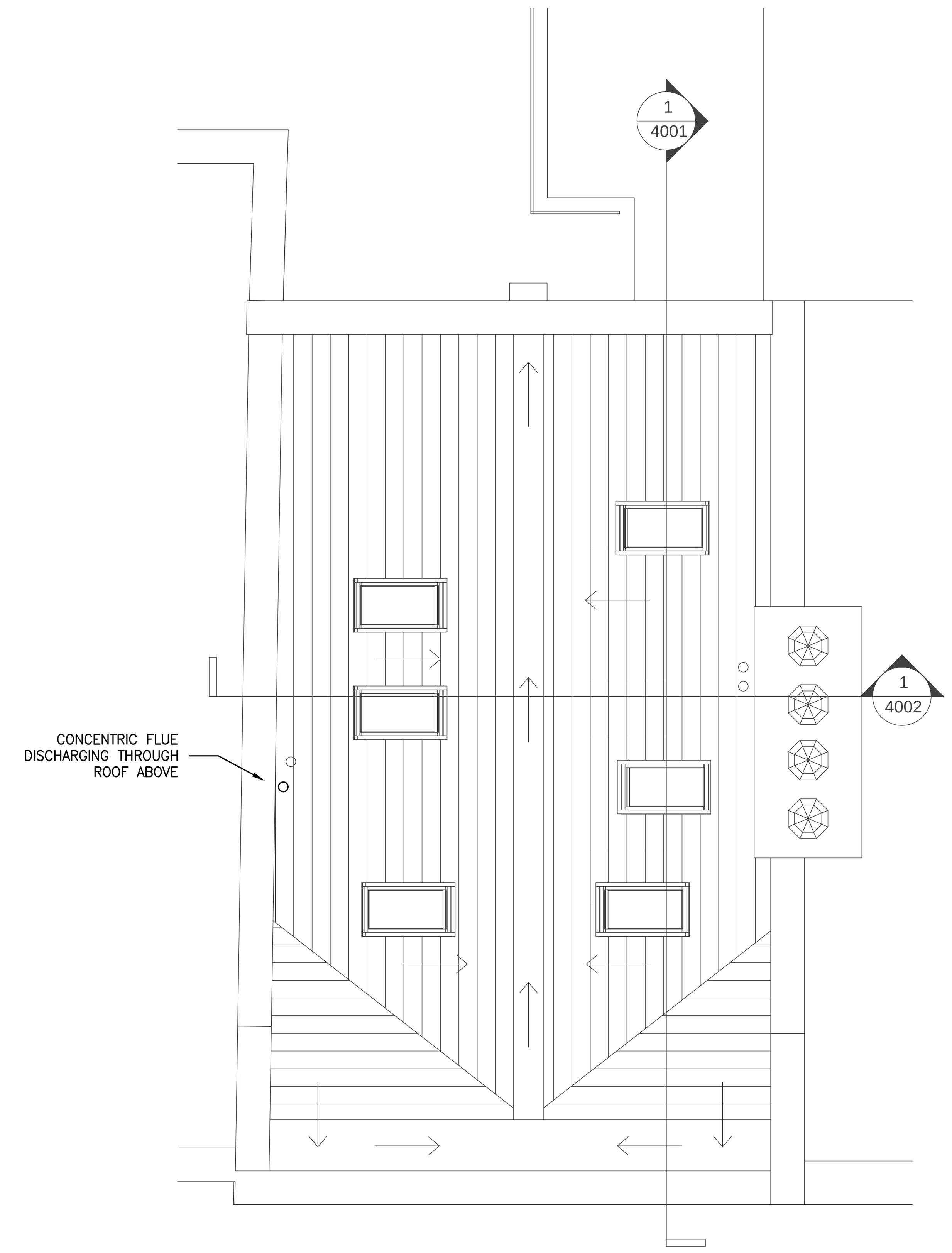
NOTE:
FLAT VENTILATION TO BE PROVIDED AS PER SYSTEM 1 – BACKGROUND VENTILATORS (TRICKLE VENTS IN THE WINDOWS) AN DINTERMITTENT EXTRACT FANS (APPROVED DOCUMENT F2010)

02 General Arrangement - Second Floor



NOTE:
FLAT VENTILATION TO BE PROVIDED AS PER SYSTEM 1 – BACKGROUND VENTILATORS (TRICKLE VENTS IN THE WINDOWS) AN DINTERMITTENT EXTRACT FANS (APPROVED DOCUMENT F2010)

03 General Arrangement - Third Floor



04 General Arrangement - Roof Plan

GENERAL NOTES

THIS DRAWING SHOULD NOT BE USED FOR SCALING. ANY SCALED DIMENSIONS ARE TO BE CONFIRMED BY THE CONTRACT ADMINISTRATOR.

UNLESS STATED OTHERWISE, ALL DIMENSIONS ARE IN MILLIMETRES.

MATERIALS AND WORKMANSHIP SHALL BE TO THE BEST OF THEIR RESPECTIVE KIND AND CONFORM WITH THE RELEVANT BRITISH & EUROPEAN STANDARDS, SPECIFICATIONS AND CODES OF PRACTICE.

THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS AND THE SERVICES SPECIFICATION DOCUMENT(S).

FAILURE TO RAISE QUERIES IN A TIMELY MANNER SHALL RESULT IN COSTS BOURNE DIRECTLY BY THE CONTRACTOR.

Rev.	Date	Description	Chkd

Status
PRELIMINARY

Consulting Engineers
t - 0207 193 7146 www.BSE3d.com

Client
SUDAJ LTD

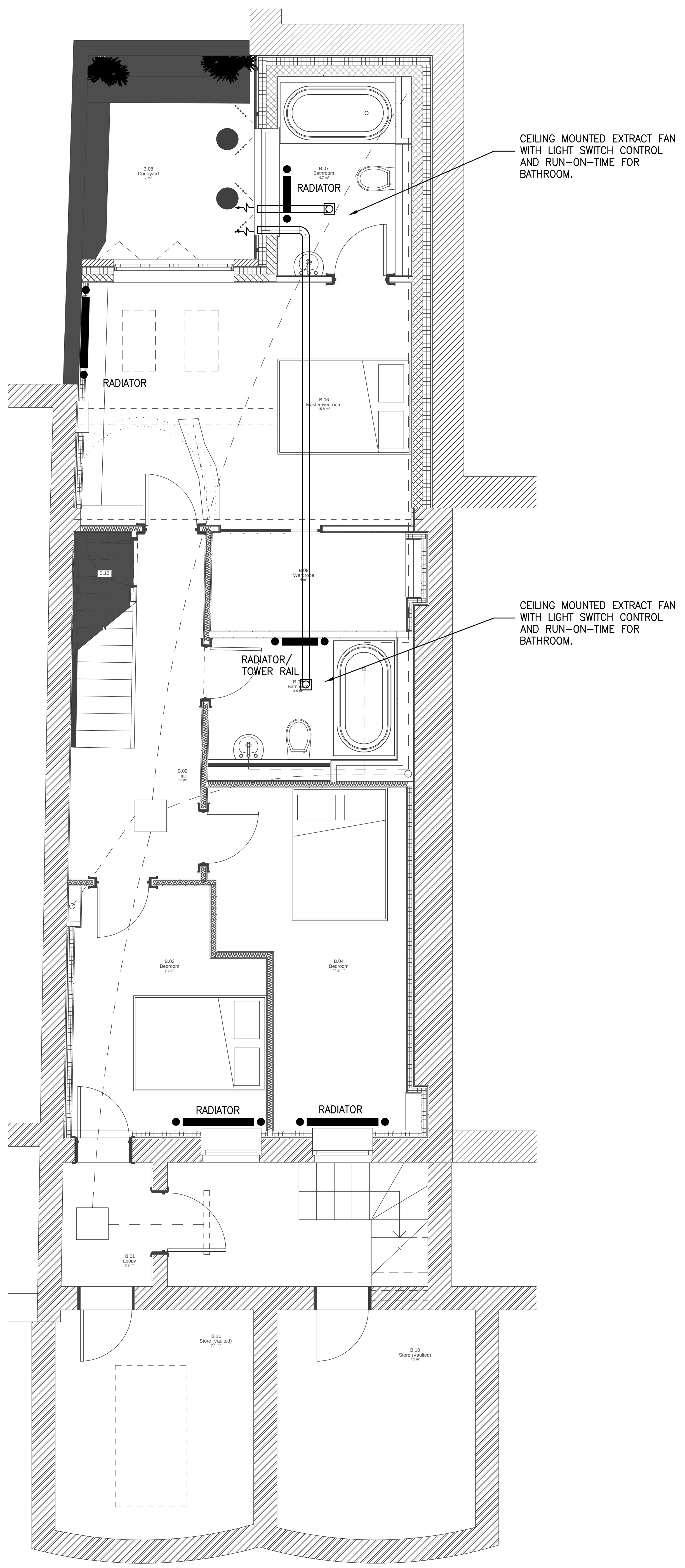
Architect
AWW

Project
82 GUILDFORD STREET, BLOOMSBURY, LONDON

Drawing Title
HEATING AND VENTILATION OUTLINE LAYOUT

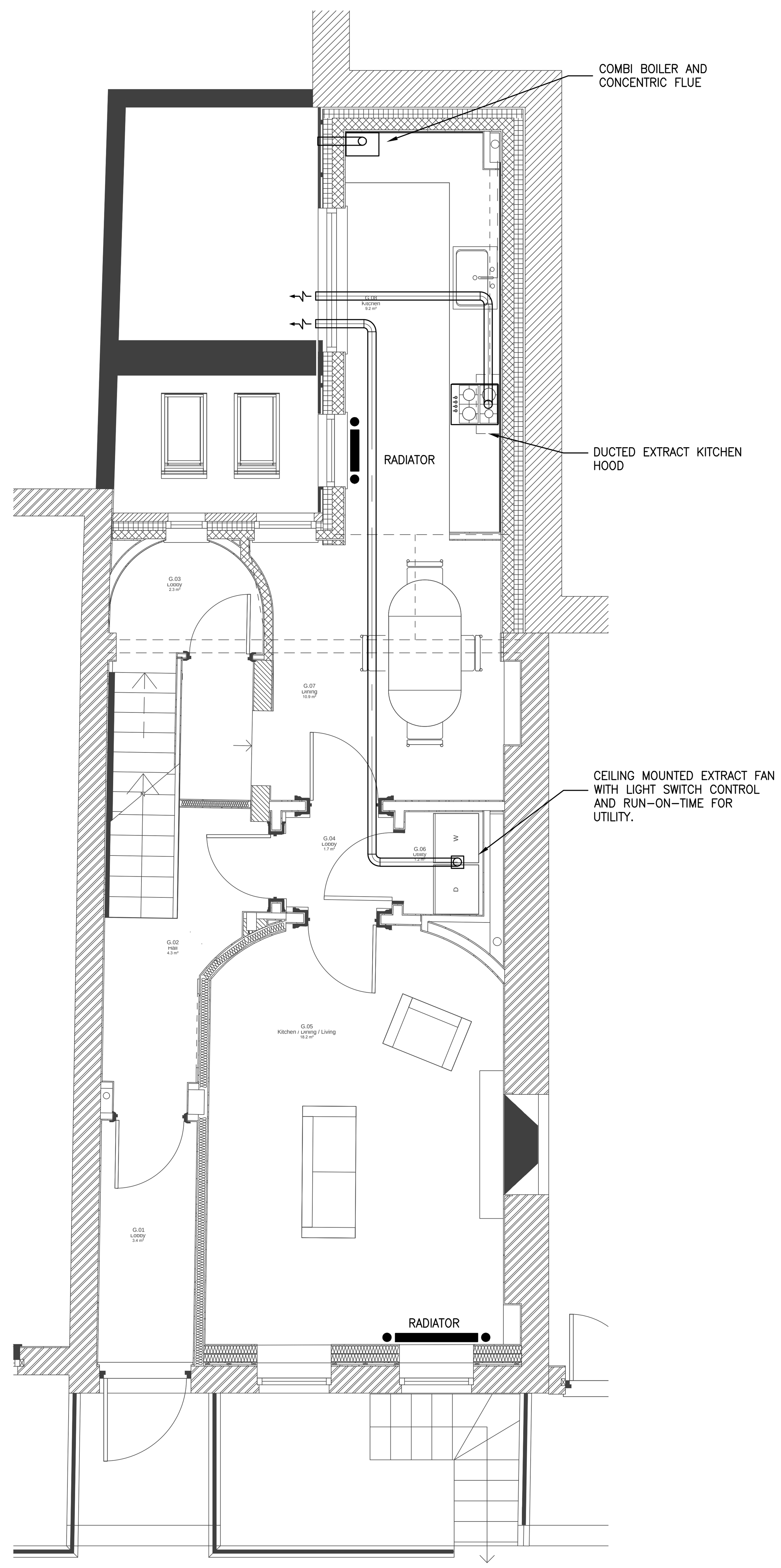
Scale	Date		
1:50 @ A1	01.08.2014		
Engineer FP	Drawn AW	Checked DG	Approved PT

Drawing No. P3124-40-SK-02 Rev. P1



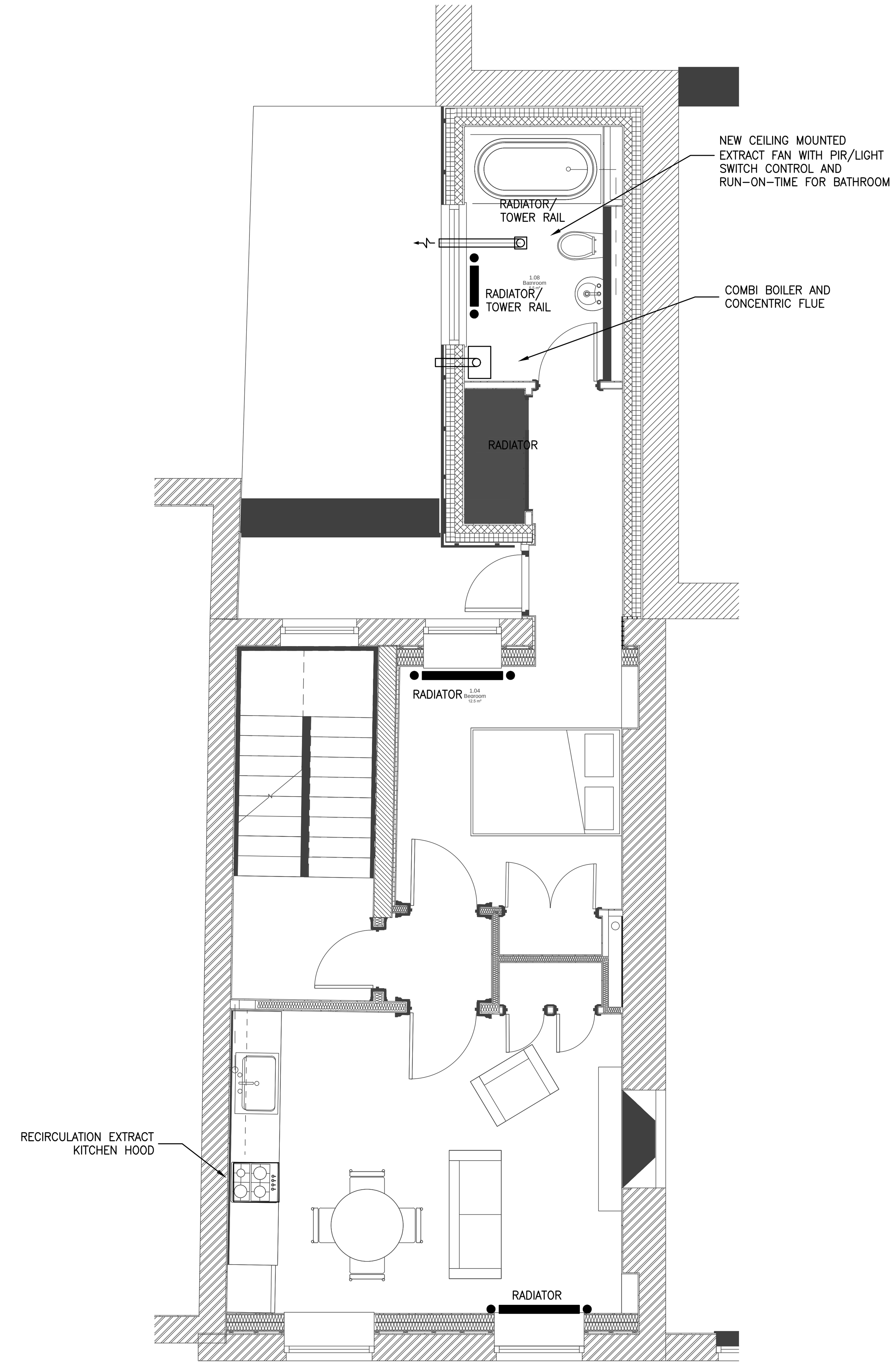
NOTE:
FLAT VENTILATION TO BE PROVIDED AS PER SYSTEM 1 – BACKGROUND VENTILATORS (TRICKLE VENTS IN THE WINDOWS) AN DINTERMITTENT EXTRACT FANS (APPROVED DOCUMENT F2010)

-01 General Arrangement - Basement Level



NOTE:
FLAT VENTILATION TO BE PROVIDED AS PER SYSTEM 1 – BACKGROUND VENTILATORS (TRICKLE VENTS IN THE WINDOWS) AN DINTERMITTENT EXTRACT FANS (APPROVED DOCUMENT F2010)

00 General Arrangement - Ground Floor



NOTE:
FLAT VENTILATION TO BE PROVIDED AS PER SYSTEM 1 – BACKGROUND VENTILATORS (TRICKLE VENTS IN THE WINDOWS) AN DINTERMITTENT EXTRACT FANS (APPROVED DOCUMENT F2010)

01 General Arrangement - First Floor

GENERAL NOTES

THIS DRAWING SHOULD NOT BE USED FOR SCALING. ANY SCALED DIMENSIONS ARE TO BE CONFIRMED BY THE CONTRACT ADMINISTRATOR.

UNLESS STATED OTHERWISE, ALL DIMENSIONS ARE IN MILLIMETRES.

MATERIALS AND WORKMANSHIP SHALL BE TO THE BEST OF THEIR RESPECTIVE KIND AND CONFORM WITH THE RELEVANT BRITISH & EUROPEAN STANDARDS, SPECIFICATIONS AND CODES OF PRACTICE.

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Rev.	Date	Description	Chkd

Status
PRELIMINARY

Consulting Engineers
t - 0207 193 7146 www.BSE3d.com

Client
SUDAJ LTD

Architect
AWW

Project
82 GUILDFORD STREET, BLOOMSBURY, LONDON

Drawing Title
HEATING AND VENTILATION OUTLINE LAYOUT

Scale	Date		
1:50 @ A1	01.08.2014		
Engineer FP	Drawn AW	Checked DG	Approved PT
Drawing No. P3124-40-SK-01		Rev. P1	

Appendix B

SAP calculations

Predicted Energy Assessment

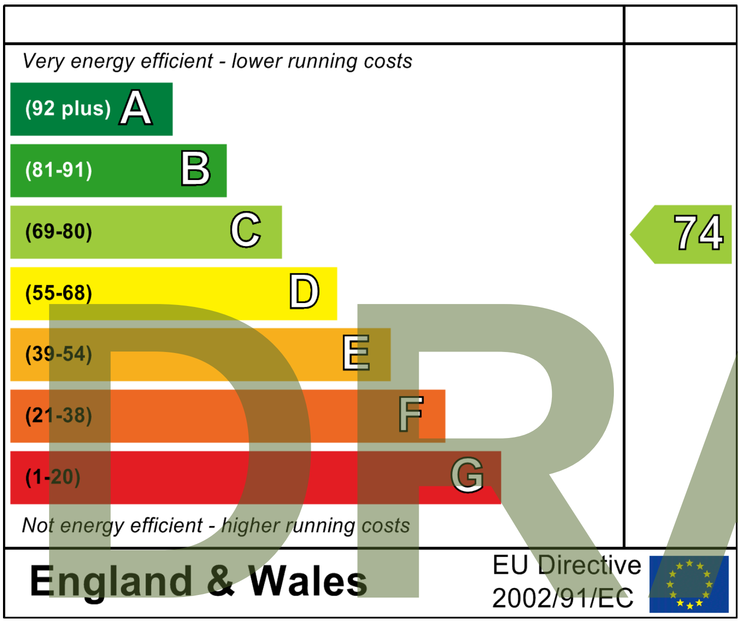
82 Guilford Street
London
WC1N 1DF

Dwelling type:	Top floor Flat
Date of assessment:	15 July 2014
Produced by:	Stroma Certification
Total floor area:	34.6 m²

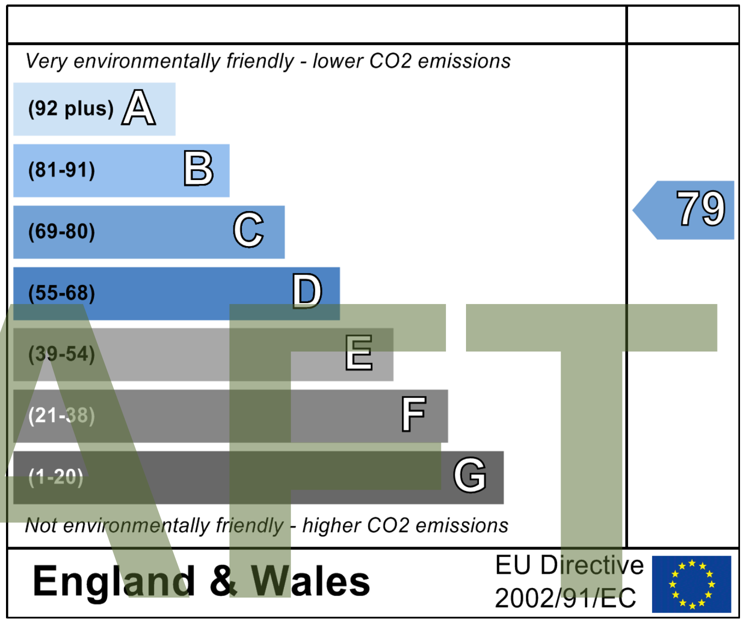
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2009 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Test User	**Stroma Number:**	STRO000000
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.74

Property Address: Third floor flat

Address : 82 Guilford Street, London, WC1N 1DF

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Basement	34.6	(1a) x	2.693	(2a) =	93.18	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	34.6	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		93.18	(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) =	0.21	(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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.71	(18)

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

Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.82	0.77	0.77	0.68	0.62	0.59	0.56	0.56	0.64	0.68	0.73	0.77

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=	0.84	0.8	0.8	0.73	0.69	0.68	0.66	0.66	0.7	0.73	0.77	0.8	(24d)

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

(25)m=	0.84	0.8	0.8	0.73	0.69	0.68	0.66	0.66	0.7	0.73	0.77	0.8	(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	
Doors			1.91	x	1.8	=	3.438			(26)
Windows Type 1			1.39	x1/[1/(2.4)+ 0.04]		=	3.04			(27)
Windows Type 2			1.85	x1/[1/(1.2)+ 0.04]		=	2.12			(27)
Rooflights Type 1			0.53	x1/[1/(1.2) + 0.04]		=	0.636			(27b)
Rooflights Type 2			0.36	x1/[1/(1.2) + 0.04]		=	0.432			(27b)
Walls	21.79	1.91	19.88	x	0.17	=	3.38			(29)
Roof	34.6	1.78	32.82	x	0.15	=	4.92			(30)
Total area of elements, m²			61.024							(31)

** 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) = 21.99 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 633.408 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 9.15 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 31.14 (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=	25.71	24.6	24.6	22.55	21.33	20.77	20.23	20.23	21.63	22.55	23.54	24.6	(38)

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

(39)m=	56.85	55.74	55.74	53.69	52.47	51.91	51.37	51.37	52.77	53.69	54.68	55.74	

Average = Sum(39)$_{1…12}$ /12= 53.83 (39)

SAP WorkSheet: New dwelling design stage

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

(40)m=	1.64	1.61	1.61	1.55	1.52	1.5	1.48	1.48	1.53	1.55	1.58	1.61

Average = Sum(40)$_{1…12}$ /12= 1.56 (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 1.27 (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 64.4 (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=	70.83	68.26	65.68	63.11	60.53	57.96	57.96	60.53	63.11	65.68	68.26	70.83

Total = Sum(44)$_{1…12}$ = 772.74 (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=	105.3	92.09	95.03	82.85	79.5	68.6	63.57	72.95	73.82	86.03	93.9	101.97

Total = Sum(45)$_{1…12}$ = 1015.61 (45)

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

(46)m=	15.79	13.81	14.25	12.43	11.92	10.29	9.54	10.94	11.07	12.9	14.09	15.3	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) 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=	36.1	31.42	33.47	31.12	30.85	28.58	29.53	30.85	31.12	33.47	33.66	36.1	(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=	141.39	123.51	128.5	113.97	110.34	97.18	93.1	103.79	104.94	119.5	127.57	138.07	(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=	141.39	123.51	128.5	113.97	110.34	97.18	93.1	103.79	104.94	119.5	127.57	138.07

Output from water heater (annual)$_{1...12}$ 1401.87 (64)

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

(65)m=	44.04	38.48	39.97	35.33	34.14	29.95	28.52	31.97	32.32	36.97	39.64	42.93	(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=	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	28.95	25.71	20.91	15.83	11.83	9.99	10.79	14.03	18.83	23.91	27.91	29.75	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	161.54	163.21	158.99	150	138.65	127.98	120.85	119.17	123.4	132.39	143.74	154.41	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	(71)
Water heating gains (Table 5)													
(72)m=	59.19	57.26	53.72	49.07	45.89	41.6	38.33	42.97	44.9	49.69	55.05	57.7	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	329	325.51	312.94	294.22	275.7	258.9	249.3	255.5	266.45	285.32	306.03	321.19	(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	1	x	1.39	x	37.39	x	0.76	x	0.7	=	49.77	(77)
Southeast 0.9x	1	x	1.39	x	63.74	x	0.76	x	0.7	=	84.84	(77)
Southeast 0.9x	1	x	1.39	x	84.22	x	0.76	x	0.7	=	112.1	(77)
Southeast 0.9x	1	x	1.39	x	103.49	x	0.76	x	0.7	=	137.75	(77)
Southeast 0.9x	1	x	1.39	x	113.34	x	0.76	x	0.7	=	150.86	(77)
Southeast 0.9x	1	x	1.39	x	115.04	x	0.76	x	0.7	=	153.13	(77)
Southeast 0.9x	1	x	1.39	x	112.79	x	0.76	x	0.7	=	150.13	(77)
Southeast 0.9x	1	x	1.39	x	105.34	x	0.76	x	0.7	=	140.22	(77)

Southeast	0.9x	1	x	1.39	x	92.9	x	0.76	x	0.7	=	123.65	(77)
Southeast	0.9x	1	x	1.39	x	72.36	x	0.76	x	0.7	=	96.32	(77)
Southeast	0.9x	1	x	1.39	x	44.83	x	0.76	x	0.7	=	59.67	(77)
Southeast	0.9x	1	x	1.39	x	31.95	x	0.76	x	0.7	=	42.53	(77)
Northwest	0.9x	1	x	1.85	x	11.51	x	0.63	x	0.7	=	8.45	(81)
Northwest	0.9x	1	x	1.85	x	23.55	x	0.63	x	0.7	=	17.3	(81)
Northwest	0.9x	1	x	1.85	x	41.13	x	0.63	x	0.7	=	30.2	(81)
Northwest	0.9x	1	x	1.85	x	67.8	x	0.63	x	0.7	=	49.78	(81)
Northwest	0.9x	1	x	1.85	x	89.77	x	0.63	x	0.7	=	65.91	(81)
Northwest	0.9x	1	x	1.85	x	97.5	x	0.63	x	0.7	=	71.59	(81)
Northwest	0.9x	1	x	1.85	x	92.98	x	0.63	x	0.7	=	68.27	(81)
Northwest	0.9x	1	x	1.85	x	75.42	x	0.63	x	0.7	=	55.38	(81)
Northwest	0.9x	1	x	1.85	x	51.24	x	0.63	x	0.7	=	37.63	(81)
Northwest	0.9x	1	x	1.85	x	29.6	x	0.63	x	0.7	=	21.73	(81)
Northwest	0.9x	1	x	1.85	x	14.52	x	0.63	x	0.7	=	10.67	(81)
Northwest	0.9x	1	x	1.85	x	9.36	x	0.63	x	0.7	=	6.87	(81)
Rooflights	0.9x	1	x	0.53	x	26	x	0.63	x	0.8	=	12.5	(82)
Rooflights	0.9x	1	x	0.36	x	26	x	0.63	x	0.8	=	8.49	(82)
Rooflights	0.9x	1	x	0.53	x	54	x	0.63	x	0.8	=	25.96	(82)
Rooflights	0.9x	1	x	0.36	x	54	x	0.63	x	0.8	=	17.64	(82)
Rooflights	0.9x	1	x	0.53	x	94	x	0.63	x	0.8	=	45.2	(82)
Rooflights	0.9x	1	x	0.36	x	94	x	0.63	x	0.8	=	30.7	(82)
Rooflights	0.9x	1	x	0.53	x	150	x	0.63	x	0.8	=	72.12	(82)
Rooflights	0.9x	1	x	0.36	x	150	x	0.63	x	0.8	=	48.99	(82)
Rooflights	0.9x	1	x	0.53	x	190	x	0.63	x	0.8	=	91.36	(82)
Rooflights	0.9x	1	x	0.36	x	190	x	0.63	x	0.8	=	62.05	(82)
Rooflights	0.9x	1	x	0.53	x	201	x	0.63	x	0.8	=	96.64	(82)
Rooflights	0.9x	1	x	0.36	x	201	x	0.63	x	0.8	=	65.64	(82)
Rooflights	0.9x	1	x	0.53	x	194	x	0.63	x	0.8	=	93.28	(82)
Rooflights	0.9x	1	x	0.36	x	194	x	0.63	x	0.8	=	63.36	(82)
Rooflights	0.9x	1	x	0.53	x	164	x	0.63	x	0.8	=	78.85	(82)
Rooflights	0.9x	1	x	0.36	x	164	x	0.63	x	0.8	=	53.56	(82)
Rooflights	0.9x	1	x	0.53	x	116	x	0.63	x	0.8	=	55.77	(82)
Rooflights	0.9x	1	x	0.36	x	116	x	0.63	x	0.8	=	37.88	(82)
Rooflights	0.9x	1	x	0.53	x	68	x	0.63	x	0.8	=	32.7	(82)
Rooflights	0.9x	1	x	0.36	x	68	x	0.63	x	0.8	=	22.21	(82)
Rooflights	0.9x	1	x	0.53	x	33	x	0.63	x	0.8	=	15.87	(82)
Rooflights	0.9x	1	x	0.36	x	33	x	0.63	x	0.8	=	10.78	(82)
Rooflights	0.9x	1	x	0.53	x	21	x	0.63	x	0.8	=	10.1	(82)
Rooflights	0.9x	1	x	0.36	x	21	x	0.63	x	0.8	=	6.86	(82)

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

(83)m=	79.21	145.73	218.19	308.64	370.18	387.01	375.04	328.01	254.94	172.96	96.98	66.36	(83)

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

(84)m=	408.21	471.24	531.13	602.86	645.88	645.91	624.34	583.5	521.39	458.28	403.01	387.55	(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=	0.9	0.86	0.8	0.72	0.59	0.45	0.32	0.34	0.55	0.75	0.86	0.9	(86)

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

(87)m=	18.48	18.84	19.38	19.97	20.51	20.81	20.94	20.93	20.69	20.07	19.13	18.56	(87)

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

(88)m=	19.59	19.61	19.61	19.65	19.68	19.69	19.7	19.7	19.67	19.65	19.63	19.61	(88)

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

(89)m=	0.88	0.84	0.78	0.68	0.53	0.37	0.22	0.24	0.47	0.7	0.84	0.88	(89)

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

(90)m=	17.39	17.75	18.27	18.84	19.34	19.59	19.68	19.68	19.49	18.95	18.05	17.48	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

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

(92)m=	17.92	18.28	18.81	19.39	19.91	20.19	20.3	20.3	20.08	19.5	18.58	18.01	(92)

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

(93)m=	17.92	18.28	18.81	19.39	19.91	20.19	20.3	20.3	20.08	19.5	18.58	18.01	(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=	0.86	0.82	0.76	0.67	0.54	0.4	0.27	0.28	0.5	0.69	0.82	0.86	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	349.77	385.79	402.25	403.9	350.76	261.18	167.44	166.21	258.07	317.75	330.89	333.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	763.13	740.41	669.58	574.21	430.89	290.06	174.75	174.49	305.12	467.07	633.24	730.75	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	307.53	238.31	198.89	122.62	59.61	0	0	0	0	111.1	217.69	295.42	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1551.18 | (98)

Space heating requirement in kWh/m²/year | 44.83 | (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)

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Efficiency of main space heating system 1	92.6	(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)														
	307.53	238.31	198.89	122.62	59.61	0	0	0	0	111.1	217.69	295.42		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	332.11	257.35	214.79	132.42	64.38	0	0	0	0	119.98	235.09	319.03		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1675.14	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)	141.39	123.51	128.5	113.97	110.34	97.18	93.1	103.79	104.94	119.5	127.57	138.07		
Efficiency of water heater													79.5	(216)
(217)m=	86.15	85.88	85.34	84.43	82.77	79.5	79.5	79.5	79.5	84.07	85.58	86.12		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	164.12	143.83	150.57	134.99	133.31	122.24	117.11	130.56	132	142.15	149.06	160.33		
Total = Sum(219a)$_{1...12}$ =													1680.25	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1675.14	
Water heating fuel used			1680.25	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			204.48	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.1	x 0.01 =	51.9294	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.1	x 0.01 =	52.09	(247)
Pumps, fans and electric keep-hot	(231)		11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)		11.46	x 0.01 =	23.43	(250)
Additional standing charges (Table 12)					106	(251)

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Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	253.5058	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.4968	(257)
SAP rating (Section 12)		79.1192	(258)

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	0.198	=	331.68	(261)
Space heating (secondary)	(215)	x	0	=	0	(263)
Water heating	(219)	x	0.198	=	332.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =				664.37	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.517	=	90.48	(267)
Electricity for lighting	(232)	x	0.517	=	105.72	(268)
Total CO2, kg/year			sum of (265)…(271) =		860.56	(272)
CO2 emissions per m²			(272) ÷ (4) =		24.87	(273)
EI rating (section 14)					86	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.02	=	1708.64	(261)
Space heating (secondary)	(215)	x	0	=	0	(263)
Energy for water heating	(219)	x	1.02	=	1713.86	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3422.5	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	2.92	=	511	(267)
Electricity for lighting	(232)	x	0	=	597.09	(268)
‘Total Primary Energy			sum of (265)…(271) =		4530.59	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		130.94	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Test User	**Stroma Number:**	STRO000000
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.74

Property Address: Third floor existing

Address : 82 Guilford Street, London, WC1N 1DF

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Basement	34.6	(1a) x	2.693	(2a) =	93.18	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	34.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	93.18	(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) =	0.21	(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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.71	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.82	0.77	0.77	0.68	0.62	0.59	0.56	0.56	0.64	0.68	0.73	0.77

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=	0.84	0.8	0.8	0.73	0.69	0.68	0.66	0.66	0.7	0.73	0.77	0.8	(24d)

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

(25)m=	0.84	0.8	0.8	0.73	0.69	0.68	0.66	0.66	0.7	0.73	0.77	0.8	(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	
Doors			1.91	x	1.8	=	3.438			(26)
Windows Type 1			1.39	x1/[1/(2.4)+ 0.04]		=	3.04			(27)
Windows Type 2			1.85	x1/[1/(1.6)+ 0.04]		=	2.78			(27)
Rooflights Type 1			0.53	x1/[1/(1.6) + 0.04]		=	0.848			(27b)
Rooflights Type 2			0.36	x1/[1/(1.6) + 0.04]		=	0.576			(27b)
Walls	21.79	1.91	19.88	x	0.28	=	5.57			(29)
Roof	34.6	1.78	32.82	x	0.18	=	5.91			(30)
Total area of elements, m²			61.024							(31)

** 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) = 26.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 633.408 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 9.15 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 35.61 (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=	25.71	24.6	24.6	22.55	21.33	20.77	20.23	20.23	21.63	22.55	23.54	24.6	(38)

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

(39)m=	61.33	60.21	60.21	58.17	56.95	56.38	55.84	55.84	57.24	58.17	59.16	60.21	

Average = Sum(39)$_{1…12}$ /12= 58.31 (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=	1.77	1.74	1.74	1.68	1.65	1.63	1.61	1.61	1.65	1.68	1.71	1.74

Average = Sum(40)$_{1…12}$ /12= 1.69 (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 1.27 (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 64.4 (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=	70.83	68.26	65.68	63.11	60.53	57.96	57.96	60.53	63.11	65.68	68.26	70.83

Total = Sum(44)$_{1…12}$ = 772.74 (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=	105.3	92.09	95.03	82.85	79.5	68.6	63.57	72.95	73.82	86.03	93.9	101.97

Total = Sum(45)$_{1…12}$ = 1015.61 (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=	15.79	13.81	14.25	12.43	11.92	10.29	9.54	10.94	11.07	12.9	14.09	15.3	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 150 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 1.6 (54)

Enter (49) or (54) in (55) 1.6 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	49.48	44.69	49.48	47.88	49.48	47.88	49.48	49.48	47.88	49.48	47.88	49.48	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	49.48	44.69	49.48	47.88	49.48	47.88	49.48	49.48	47.88	49.48	47.88	49.48	(57)

Primary circuit loss (annual) from Table 3 610 (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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	51.81	46.79	51.81	50.14	51.81	50.14	51.81	51.81	50.14	51.81	50.14	51.81	(59)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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=	206.58	183.58	196.32	180.87	180.78	166.62	164.85	174.23	171.83	187.31	191.92	203.26	(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=	206.58	183.58	196.32	180.87	180.78	166.62	164.85	174.23	171.83	187.31	191.92	203.26	

Output from water heater (annual)$_{1...12}$ 2208.15 (64)

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

(65)m=	116.04	103.81	112.63	105.96	107.46	101.22	102.16	105.28	102.96	109.63	109.64	114.93	(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=	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	76.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	41.01	36.42	29.62	22.42	16.76	14.15	15.29	19.88	26.68	33.87	39.54	42.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	161.54	163.21	158.99	150	138.65	127.98	120.85	119.17	123.4	132.39	143.74	154.41	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	-50.85	(71)
Water heating gains (Table 5)													
(72)m=	155.97	154.47	151.38	147.17	144.44	140.59	137.32	141.51	143	147.35	152.27	154.48	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	437.84	433.44	419.32	398.92	379.17	362.04	352.79	359.88	372.4	392.94	414.88	430.37	(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	1	x	1.39	x	37.39	x	0.76	x	0.7	=	49.77	(77)
Southeast 0.9x	1	x	1.39	x	63.74	x	0.76	x	0.7	=	84.84	(77)
Southeast 0.9x	1	x	1.39	x	84.22	x	0.76	x	0.7	=	112.1	(77)
Southeast 0.9x	1	x	1.39	x	103.49	x	0.76	x	0.7	=	137.75	(77)
Southeast 0.9x	1	x	1.39	x	113.34	x	0.76	x	0.7	=	150.86	(77)
Southeast 0.9x	1	x	1.39	x	115.04	x	0.76	x	0.7	=	153.13	(77)
Southeast 0.9x	1	x	1.39	x	112.79	x	0.76	x	0.7	=	150.13	(77)
Southeast 0.9x	1	x	1.39	x	105.34	x	0.76	x	0.7	=	140.22	(77)

Southeast 0.9x	1	x	1.39	x	92.9	x	0.76	x	0.7	=	123.65	(77)
Southeast 0.9x	1	x	1.39	x	72.36	x	0.76	x	0.7	=	96.32	(77)
Southeast 0.9x	1	x	1.39	x	44.83	x	0.76	x	0.7	=	59.67	(77)
Southeast 0.9x	1	x	1.39	x	31.95	x	0.76	x	0.7	=	42.53	(77)
Northwest 0.9x	1	x	1.85	x	11.51	x	0.63	x	0.7	=	8.45	(81)
Northwest 0.9x	1	x	1.85	x	23.55	x	0.63	x	0.7	=	17.3	(81)
Northwest 0.9x	1	x	1.85	x	41.13	x	0.63	x	0.7	=	30.2	(81)
Northwest 0.9x	1	x	1.85	x	67.8	x	0.63	x	0.7	=	49.78	(81)
Northwest 0.9x	1	x	1.85	x	89.77	x	0.63	x	0.7	=	65.91	(81)
Northwest 0.9x	1	x	1.85	x	97.5	x	0.63	x	0.7	=	71.59	(81)
Northwest 0.9x	1	x	1.85	x	92.98	x	0.63	x	0.7	=	68.27	(81)
Northwest 0.9x	1	x	1.85	x	75.42	x	0.63	x	0.7	=	55.38	(81)
Northwest 0.9x	1	x	1.85	x	51.24	x	0.63	x	0.7	=	37.63	(81)
Northwest 0.9x	1	x	1.85	x	29.6	x	0.63	x	0.7	=	21.73	(81)
Northwest 0.9x	1	x	1.85	x	14.52	x	0.63	x	0.7	=	10.67	(81)
Northwest 0.9x	1	x	1.85	x	9.36	x	0.63	x	0.7	=	6.87	(81)
Rooflights 0.9x	1	x	0.53	x	26	x	0.63	x	0.8	=	12.5	(82)
Rooflights 0.9x	1	x	0.36	x	26	x	0.63	x	0.8	=	8.49	(82)
Rooflights 0.9x	1	x	0.53	x	54	x	0.63	x	0.8	=	25.96	(82)
Rooflights 0.9x	1	x	0.36	x	54	x	0.63	x	0.8	=	17.64	(82)
Rooflights 0.9x	1	x	0.53	x	94	x	0.63	x	0.8	=	45.2	(82)
Rooflights 0.9x	1	x	0.36	x	94	x	0.63	x	0.8	=	30.7	(82)
Rooflights 0.9x	1	x	0.53	x	150	x	0.63	x	0.8	=	72.12	(82)
Rooflights 0.9x	1	x	0.36	x	150	x	0.63	x	0.8	=	48.99	(82)
Rooflights 0.9x	1	x	0.53	x	190	x	0.63	x	0.8	=	91.36	(82)
Rooflights 0.9x	1	x	0.36	x	190	x	0.63	x	0.8	=	62.05	(82)
Rooflights 0.9x	1	x	0.53	x	201	x	0.63	x	0.8	=	96.64	(82)
Rooflights 0.9x	1	x	0.36	x	201	x	0.63	x	0.8	=	65.64	(82)
Rooflights 0.9x	1	x	0.53	x	194	x	0.63	x	0.8	=	93.28	(82)
Rooflights 0.9x	1	x	0.36	x	194	x	0.63	x	0.8	=	63.36	(82)
Rooflights 0.9x	1	x	0.53	x	164	x	0.63	x	0.8	=	78.85	(82)
Rooflights 0.9x	1	x	0.36	x	164	x	0.63	x	0.8	=	53.56	(82)
Rooflights 0.9x	1	x	0.53	x	116	x	0.63	x	0.8	=	55.77	(82)
Rooflights 0.9x	1	x	0.36	x	116	x	0.63	x	0.8	=	37.88	(82)
Rooflights 0.9x	1	x	0.53	x	68	x	0.63	x	0.8	=	32.7	(82)
Rooflights 0.9x	1	x	0.36	x	68	x	0.63	x	0.8	=	22.21	(82)
Rooflights 0.9x	1	x	0.53	x	33	x	0.63	x	0.8	=	15.87	(82)
Rooflights 0.9x	1	x	0.36	x	33	x	0.63	x	0.8	=	10.78	(82)
Rooflights 0.9x	1	x	0.53	x	21	x	0.63	x	0.8	=	10.1	(82)
Rooflights 0.9x	1	x	0.36	x	21	x	0.63	x	0.8	=	6.86	(82)

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

(83)m=	79.21	145.73	218.19	308.64	370.18	387.01	375.04	328.01	254.94	172.96	96.98	66.36	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	517.05	579.17	637.51	707.56	749.35	749.06	727.83	687.89	627.34	565.9	511.85	496.72	(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=	0.86	0.82	0.77	0.68	0.56	0.42	0.3	0.31	0.5	0.69	0.82	0.86	(86)

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

(87)m=	18.59	18.91	19.43	19.98	20.51	20.81	20.94	20.93	20.71	20.12	19.23	18.67	(87)

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

(88)m=	19.49	19.52	19.52	19.56	19.58	19.6	19.61	19.61	19.58	19.56	19.54	19.52	(88)

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

(89)m=	0.84	0.8	0.73	0.64	0.5	0.35	0.2	0.21	0.42	0.64	0.79	0.84	(89)

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

(90)m=	17.43	17.75	18.24	18.77	19.25	19.5	19.59	19.59	19.42	18.92	18.08	17.53	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

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

(92)m=	18	18.32	18.82	19.37	19.87	20.14	20.25	20.25	20.05	19.51	18.65	18.09	(92)

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

(93)m=	18	18.32	18.82	19.37	19.87	20.14	20.25	20.25	20.05	19.51	18.65	18.09	(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=	0.81	0.78	0.72	0.63	0.51	0.38	0.25	0.26	0.45	0.64	0.77	0.81	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	419.65	449	456.05	447.3	382.45	282.29	179.59	178.56	283.08	361.89	393.74	404.13	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	827.68	802.21	723.89	620.52	465.08	312.32	187.23	187	329.1	506.73	688.88	794.26	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	303.57	237.36	199.27	124.72	61.48	0	0	0	0	107.76	212.51	290.26	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1536.92 | (98)

Space heating requirement in kWh/m²/year | 44.42 | (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)

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Efficiency of main space heating system 1	78.9 (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)														
	303.57	237.36	199.27	124.72	61.48	0	0	0	0	107.76	212.51	290.26		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	384.75	300.83	252.56	158.07	77.92	0	0	0	0	136.58	269.34	367.88		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1947.94	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)	206.58	183.58	196.32	180.87	180.78	166.62	164.85	174.23	171.83	187.31	191.92	203.26		
Efficiency of water heater													68.8	(216)
(217)m=	74.47	74.15	73.54	72.59	71.11	68.8	68.8	68.8	68.8	72.17	73.76	74.4		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	277.39	247.56	266.94	249.16	254.23	242.18	239.61	253.24	249.76	259.53	260.19	273.19		
Total = Sum(219a)$_{1...12}$ =													3072.98	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1947.94	
Water heating fuel used			3072.98	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			289.68	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	60.3861	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	95.26	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	33.2	(250)
Additional standing charges (Table 12)				106	(251)

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Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)…(254) =	314.901	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.8593	(257)
SAP rating (Section 12)		74.0622	(258)

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	0.198	=	385.69	(261)
Space heating (secondary)	(215)	x	0	=	0	(263)
Water heating	(219)	x	0.198	=	608.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =				994.14	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.517	=	90.48	(267)
Electricity for lighting	(232)	x	0.517	=	149.77	(268)
Total CO2, kg/year			sum of (265)…(271) =		1234.38	(272)
CO2 emissions per m²			(272) ÷ (4) =		35.68	(273)
EI rating (section 14)					79	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.02	=	1986.9	(261)
Space heating (secondary)	(215)	x	0	=	0	(263)
Energy for water heating	(219)	x	1.02	=	3134.44	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5121.34	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	2.92	=	511	(267)
Electricity for lighting	(232)	x	0	=	845.87	(268)
'Total Primary Energy			sum of (265)…(271) =		6478.21	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		187.23	(273)

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User Details:

Assessor Name:	Test User	**Stroma Number:**	STRO000000
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.74

Property Address: Ground floor maisonette proposed

Address : 82 Guilford Street, London, WC1N 1DF

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Basement	45.71	(1a)	x	2.4	(2a)	=	109.7	(3a)
Ground floor	40.51	(1b)	x	3.46	(2b)	=	140.16	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.22	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	249.87	(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							4	x 10 =	40	(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) =	40	÷ (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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.66	(18)

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

Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.56	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.76	0.72	0.72	0.63	0.58	0.55	0.52	0.52	0.59	0.63	0.67	0.72

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=	0.79	0.76	0.76	0.7	0.67	0.65	0.63	0.63	0.67	0.7	0.73	0.76	(24d)

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

(25)m=	0.79	0.76	0.76	0.7	0.67	0.65	0.63	0.63	0.67	0.7	0.73	0.76	(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	
Doors Type 1			1.89	x	1.6	=	3.024			(26)
Doors Type 2			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.29	x1/[1/(2.4)+ 0.04]		=	2.82			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			3.82	x1/[1/(1.8)+ 0.04]		=	6.41			(27)
Windows Type 4			2.32	x1/[1/(2.4)+ 0.04]		=	5.08			(27)
Windows Type 5			1.61	x1/[1/(1.2)+ 0.04]		=	1.84			(27)
Windows Type 6			0.61	x1/[1/(1.2)+ 0.04]		=	0.7			(27)
Rooflights			0.41	x1/[1/(1.2) + 0.04]		=	0.492			(27b)
Floor			45.71	x	0.15	=	6.86			(28)
Walls Type1	72.16	7.22	64.94	x	0.17	=	11.04			(29)
Walls Type2	33.65	8.43	25.22	x	0.17	=	4.29			(29)
Walls Type3	42.17	3.78	38.39	x	0.24	=	9.07			(29)
Walls Type4	6.26	0	6.26	x	0.39	=	2.44			(29)
Roof	4.84	0.82	4.02	x	0.15	=	0.6			(30)
Total area of elements, m²			204.789							(31)

** 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) = 68.78 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	8478.6729	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(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		30.72	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	99.5	(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=	64.88	62.33	62.33	57.65	54.86	53.57	52.33	52.33	55.54	57.65	59.92	62.33	(38)

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

(39)m=	164.39	161.83	161.83	157.16	154.37	153.07	151.84	151.84	155.04	157.16	159.42	161.83	

Average = $Sum(39)_{1…12}$ /12= 157.48 (39)

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

(40)m=	1.91	1.88	1.88	1.82	1.79	1.78	1.76	1.76	1.8	1.82	1.85	1.88

Average = $Sum(40)_{1…12}$ /12= 1.83 (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 — 2.57 (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 — 95.25 (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=	104.77	100.96	97.15	93.34	89.53	85.72	85.72	89.53	93.34	97.15	100.96	104.77

Total = $Sum(44)_{1…12}$ = 1142.95 (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=	155.74	136.21	140.56	122.54	117.58	101.47	94.02	107.89	109.18	127.24	138.89	150.83

Total = $Sum(45)_{1…12}$ = 1502.18 (45)

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

(46)m=	23.36	20.43	21.08	18.38	17.64	15.22	14.1	16.18	16.38	19.09	20.83	22.62	(46)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day):		0	(47)
Temperature factor from Table 2b		0	(48)
Energy lost from water storage, kWh/year	(47) x (48) =	0	(49)

If manufacturer’s declared cylinder loss factor is not known:

Cylinder volume (litres) including any solar storage within same	0	(50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
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	((50) x (51) x (52) x (53) =	0	(54)
Enter (49) 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	49.51	46.03	45.62	42.27	43.68	45.62	46.03	49.51	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=	206.7	182.24	190.07	168.58	163.21	143.74	137.71	153.52	155.21	176.75	188.21	201.79	(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=	206.7	182.24	190.07	168.58	163.21	143.74	137.71	153.52	155.21	176.75	188.21	201.79	

Output from water heater (annual)$_{1...12}$ | 2067.72 | (64)

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

(65)m=	64.52	56.8	59.11	52.25	50.5	44.31	42.18	47.28	47.81	54.68	58.51	62.89	(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=	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	(66)

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

(67)m=	64.75	57.51	46.77	35.41	26.47	22.35	24.15	31.39	42.13	53.49	62.43	66.55	(67)

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

(68)m=	346.19	349.79	340.73	321.46	297.13	274.27	258.99	255.4	264.45	283.73	308.05	330.92	(68)

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

(69)m=	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	(71)

Water heating gains (Table 5)

(72)m=	86.73	84.52	79.45	72.57	67.88	61.54	56.7	63.55	66.4	73.5	81.27	84.53	(72)

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

(73)m=	612.07	606.22	581.36	543.84	505.88	472.55	454.24	464.74	487.38	525.11	566.15	596.4	(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)	
Southeast	0.9x	0.54	x	1.29	x	37.39	x	0.76	x	0.7	=	24.94	(77)
Southeast	0.9x	0.54	x	2.32	x	37.39	x	0.76	x	0.7	=	44.85	(77)
Southeast	0.9x	0.54	x	1.29	x	63.74	x	0.76	x	0.7	=	42.52	(77)
Southeast	0.9x	0.54	x	2.32	x	63.74	x	0.76	x	0.7	=	76.46	(77)
Southeast	0.9x	0.54	x	1.29	x	84.22	x	0.76	x	0.7	=	56.18	(77)
Southeast	0.9x	0.54	x	2.32	x	84.22	x	0.76	x	0.7	=	101.03	(77)
Southeast	0.9x	0.54	x	1.29	x	103.49	x	0.76	x	0.7	=	69.03	(77)
Southeast	0.9x	0.54	x	2.32	x	103.49	x	0.76	x	0.7	=	124.15	(77)
Southeast	0.9x	0.54	x	1.29	x	113.34	x	0.76	x	0.7	=	75.6	(77)
Southeast	0.9x	0.54	x	2.32	x	113.34	x	0.76	x	0.7	=	135.97	(77)
Southeast	0.9x	0.54	x	1.29	x	115.04	x	0.76	x	0.7	=	76.74	(77)
Southeast	0.9x	0.54	x	2.32	x	115.04	x	0.76	x	0.7	=	138.02	(77)
Southeast	0.9x	0.54	x	1.29	x	112.79	x	0.76	x	0.7	=	75.24	(77)
Southeast	0.9x	0.54	x	2.32	x	112.79	x	0.76	x	0.7	=	135.31	(77)
Southeast	0.9x	0.54	x	1.29	x	105.34	x	0.76	x	0.7	=	70.27	(77)
Southeast	0.9x	0.54	x	2.32	x	105.34	x	0.76	x	0.7	=	126.38	(77)
Southeast	0.9x	0.54	x	1.29	x	92.9	x	0.76	x	0.7	=	61.97	(77)
Southeast	0.9x	0.54	x	2.32	x	92.9	x	0.76	x	0.7	=	111.45	(77)
Southeast	0.9x	0.54	x	1.29	x	72.36	x	0.76	x	0.7	=	48.27	(77)
Southeast	0.9x	0.54	x	2.32	x	72.36	x	0.76	x	0.7	=	86.81	(77)
Southeast	0.9x	0.54	x	1.29	x	44.83	x	0.76	x	0.7	=	29.9	(77)
Southeast	0.9x	0.54	x	2.32	x	44.83	x	0.76	x	0.7	=	53.78	(77)
Southeast	0.9x	0.54	x	1.29	x	31.95	x	0.76	x	0.7	=	21.31	(77)
Southeast	0.9x	0.54	x	2.32	x	31.95	x	0.76	x	0.7	=	38.33	(77)
Northwest	0.9x	0.54	x	2.39	x	11.51	x	0.63	x	0.7	=	5.9	(81)
Northwest	0.9x	0.54	x	3.82	x	11.51	x	0.63	x	0.7	=	9.42	(81)
Northwest	0.9x	0.54	x	1.61	x	11.51	x	0.63	x	0.7	=	3.97	(81)
Northwest	0.9x	0.54	x	0.61	x	11.51	x	0.63	x	0.7	=	1.5	(81)
Northwest	0.9x	0.54	x	2.39	x	23.55	x	0.63	x	0.7	=	12.07	(81)
Northwest	0.9x	0.54	x	3.82	x	23.55	x	0.63	x	0.7	=	19.28	(81)
Northwest	0.9x	0.54	x	1.61	x	23.55	x	0.63	x	0.7	=	8.13	(81)
Northwest	0.9x	0.54	x	0.61	x	23.55	x	0.63	x	0.7	=	3.08	(81)
Northwest	0.9x	0.54	x	2.39	x	41.13	x	0.63	x	0.7	=	21.07	(81)
Northwest	0.9x	0.54	x	3.82	x	41.13	x	0.63	x	0.7	=	33.67	(81)
Northwest	0.9x	0.54	x	1.61	x	41.13	x	0.63	x	0.7	=	14.19	(81)
Northwest	0.9x	0.54	x	0.61	x	41.13	x	0.63	x	0.7	=	5.38	(81)
Northwest	0.9x	0.54	x	2.39	x	67.8	x	0.63	x	0.7	=	34.73	(81)
Northwest	0.9x	0.54	x	3.82	x	67.8	x	0.63	x	0.7	=	55.51	(81)
Northwest	0.9x	0.54	x	1.61	x	67.8	x	0.63	x	0.7	=	23.39	(81)

Northwest	0.9x	0.54	x	0.61	x	67.8	x	0.63	x	0.7	=	8.86	(81)
Northwest	0.9x	0.54	x	2.39	x	89.77	x	0.63	x	0.7	=	45.98	(81)
Northwest	0.9x	0.54	x	3.82	x	89.77	x	0.63	x	0.7	=	73.49	(81)
Northwest	0.9x	0.54	x	1.61	x	89.77	x	0.63	x	0.7	=	30.98	(81)
Northwest	0.9x	0.54	x	0.61	x	89.77	x	0.63	x	0.7	=	11.74	(81)
Northwest	0.9x	0.54	x	2.39	x	97.5	x	0.63	x	0.7	=	49.94	(81)
Northwest	0.9x	0.54	x	3.82	x	97.5	x	0.63	x	0.7	=	79.83	(81)
Northwest	0.9x	0.54	x	1.61	x	97.5	x	0.63	x	0.7	=	33.64	(81)
Northwest	0.9x	0.54	x	0.61	x	97.5	x	0.63	x	0.7	=	12.75	(81)
Northwest	0.9x	0.54	x	2.39	x	92.98	x	0.63	x	0.7	=	47.63	(81)
Northwest	0.9x	0.54	x	3.82	x	92.98	x	0.63	x	0.7	=	76.12	(81)
Northwest	0.9x	0.54	x	1.61	x	92.98	x	0.63	x	0.7	=	32.08	(81)
Northwest	0.9x	0.54	x	0.61	x	92.98	x	0.63	x	0.7	=	12.16	(81)
Northwest	0.9x	0.54	x	2.39	x	75.42	x	0.63	x	0.7	=	38.63	(81)
Northwest	0.9x	0.54	x	3.82	x	75.42	x	0.63	x	0.7	=	61.75	(81)
Northwest	0.9x	0.54	x	1.61	x	75.42	x	0.63	x	0.7	=	26.02	(81)
Northwest	0.9x	0.54	x	0.61	x	75.42	x	0.63	x	0.7	=	9.86	(81)
Northwest	0.9x	0.54	x	2.39	x	51.24	x	0.63	x	0.7	=	26.25	(81)
Northwest	0.9x	0.54	x	3.82	x	51.24	x	0.63	x	0.7	=	41.96	(81)
Northwest	0.9x	0.54	x	1.61	x	51.24	x	0.63	x	0.7	=	17.68	(81)
Northwest	0.9x	0.54	x	0.61	x	51.24	x	0.63	x	0.7	=	6.7	(81)
Northwest	0.9x	0.54	x	2.39	x	29.6	x	0.63	x	0.7	=	15.16	(81)
Northwest	0.9x	0.54	x	3.82	x	29.6	x	0.63	x	0.7	=	24.23	(81)
Northwest	0.9x	0.54	x	1.61	x	29.6	x	0.63	x	0.7	=	10.21	(81)
Northwest	0.9x	0.54	x	0.61	x	29.6	x	0.63	x	0.7	=	3.87	(81)
Northwest	0.9x	0.54	x	2.39	x	14.52	x	0.63	x	0.7	=	7.44	(81)
Northwest	0.9x	0.54	x	3.82	x	14.52	x	0.63	x	0.7	=	11.89	(81)
Northwest	0.9x	0.54	x	1.61	x	14.52	x	0.63	x	0.7	=	5.01	(81)
Northwest	0.9x	0.54	x	0.61	x	14.52	x	0.63	x	0.7	=	1.9	(81)
Northwest	0.9x	0.54	x	2.39	x	9.36	x	0.63	x	0.7	=	4.79	(81)
Northwest	0.9x	0.54	x	3.82	x	9.36	x	0.63	x	0.7	=	7.66	(81)
Northwest	0.9x	0.54	x	1.61	x	9.36	x	0.63	x	0.7	=	3.23	(81)
Northwest	0.9x	0.54	x	0.61	x	9.36	x	0.63	x	0.7	=	1.22	(81)
Rooflights	0.9x	1	x	0.41	x	26	x	0.63	x	0.8	=	9.67	(82)
Rooflights	0.9x	1	x	0.41	x	54	x	0.63	x	0.8	=	20.09	(82)
Rooflights	0.9x	1	x	0.41	x	94	x	0.63	x	0.8	=	34.96	(82)
Rooflights	0.9x	1	x	0.41	x	150	x	0.63	x	0.8	=	55.79	(82)
Rooflights	0.9x	1	x	0.41	x	190	x	0.63	x	0.8	=	70.67	(82)
Rooflights	0.9x	1	x	0.41	x	201	x	0.63	x	0.8	=	74.76	(82)
Rooflights	0.9x	1	x	0.41	x	194	x	0.63	x	0.8	=	72.16	(82)
Rooflights	0.9x	1	x	0.41	x	164	x	0.63	x	0.8	=	61	(82)

Rooflights 0.9x	1	x	0.41	x	116	x	0.63	x	0.8	=	43.15	(82)
Rooflights 0.9x	1	x	0.41	x	68	x	0.63	x	0.8	=	25.29	(82)
Rooflights 0.9x	1	x	0.41	x	33	x	0.63	x	0.8	=	12.27	(82)
Rooflights 0.9x	1	x	0.41	x	21	x	0.63	x	0.8	=	7.81	(82)

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

(83)m=	100.26	181.62	266.48	371.48	444.43	465.68	450.7	393.91	309.15	213.85	122.2	84.37	(83)

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

(84)m=	712.33	787.84	847.84	915.32	950.31	938.23	904.94	858.64	796.53	738.97	688.34	680.76	(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=	0.95	0.93	0.91	0.87	0.8	0.69	0.54	0.56	0.75	0.87	0.93	0.95	(86)

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

(87)m=	17.66	17.93	18.47	19.09	19.85	20.43	20.77	20.76	20.26	19.39	18.35	17.76	(87)

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

(88)m=	19.4	19.42	19.42	19.46	19.48	19.49	19.5	19.5	19.48	19.46	19.44	19.42	(88)

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

(89)m=	0.94	0.92	0.89	0.84	0.75	0.59	0.39	0.4	0.67	0.84	0.92	0.94	(89)

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

(90)m=	16.48	16.76	17.29	17.91	18.65	19.17	19.43	19.42	19.03	18.22	17.19	16.59	(90)

fLA = Living area ÷ (4) = 0.22 (91)

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

(92)m=	16.74	17.02	17.55	18.17	18.91	19.44	19.72	19.71	19.29	18.47	17.44	16.84	(92)

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

(93)m=	16.74	17.02	17.55	18.17	18.91	19.44	19.72	19.71	19.29	18.47	17.44	16.84	(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=	0.91	0.89	0.86	0.81	0.72	0.59	0.41	0.43	0.66	0.81	0.89	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	650.03	704.36	729.79	743.35	685.75	553.16	373.99	368.76	525.97	600.81	614.15	622.73	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2011.26	1944.55	1739.46	1488.16	1112.47	740.74	428.05	426.79	774.08	1205.88	1664.41	1933.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1012.76	833.41	751.19	536.26	317.48	0	0	0	0	450.17	756.19	974.88	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 5632.34 (98)

Space heating requirement in kWh/m²/year 65.33 (99)

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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		92.6	(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)	1012.76	833.41	751.19	536.26	317.48	0	0	0	0	450.17	756.19	974.88		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	1093.69	900.01	811.23	579.11	342.85	0	0	0	0	486.14	816.62	1052.79		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													6082.44	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)	206.7	182.24	190.07	168.58	163.21	143.74	137.71	153.52	155.21	176.75	188.21	201.79		
Efficiency of water heater													79.5	(216)
(217)m=	87.71	87.6	87.36	86.96	85.89	79.5	79.5	79.5	79.5	86.5	87.39	87.69		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	235.66	208.03	217.57	193.86	190.01	180.81	173.22	193.1	195.24	204.33	215.37	230.12		
Total = Sum(219a)$_{1...12}$ =													2437.32	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6082.44	
Water heating fuel used			2437.32	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			457.41	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	188.5556	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	75.56	(247)

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Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	11.46	x 0.01 =	52.42	(250)
Additional standing charges (Table 12)				106	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			442.5864	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.5852	(257)
SAP rating (Section 12)		77.8859	(258)

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	0.198	=	1204.32	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	482.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1686.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	236.48	(268)
Total CO2, kg/year		sum of (265)…(271) =		2013.87	(272)
CO2 emissions per m²		(272) ÷ (4) =		23.36	(273)
EI rating (section 14)				79	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.02	=	6204.09	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	2486.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =			8690.15	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	1335.63	(268)
‘Total Primary Energy		sum of (265)…(271) =		10536.78	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		122.21	(273)

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User Details:

Assessor Name:	Test User	**Stroma Number:**	STRO000000
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.74

Property Address: Ground floor maisonette existing

Address : 82 Guilford Street, London, WC1N 1DF

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Basement	45.71	(1a)	x	2.4	(2a)	=	109.7	(3a)
Ground floor	40.51	(1b)	x	3.46	(2b)	=	140.16	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.22	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	249.87	(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							4	x 10 =	40	(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) =	40	÷ (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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.66	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.51	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.69	0.65	0.65	0.58	0.52	0.5	0.47	0.47	0.54	0.58	0.61	0.65

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=	0.74	0.71	0.71	0.67	0.64	0.62	0.61	0.61	0.64	0.67	0.69	0.71	(24d)

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

(25)m=	0.74	0.71	0.71	0.67	0.64	0.62	0.61	0.61	0.64	0.67	0.69	0.71	(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	
Doors Type 1			1.89	x	1.6	=	3.024			(26)
Doors Type 2			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.29		x1/[1/(1.6)+ 0.04]	=	1.94			(27)
Windows Type 2			2.39		x1/[1/(1.6)+ 0.04]	=	3.59			(27)
Windows Type 3			3.82		x1/[1/(1.6)+ 0.04]	=	5.74			(27)
Windows Type 4			2.32		x1/[1/(1.6)+ 0.04]	=	3.49			(27)
Windows Type 5			1.61		x1/[1/(1.6)+ 0.04]	=	2.42			(27)
Windows Type 6			0.61		x1/[1/(1.6)+ 0.04]	=	0.92			(27)
Rooflights			0.41		x1/[1/(1.2) + 0.04]	=	0.492			(27b)
Floor			45.71	x	0.22	=	10.06			(28)
Walls Type1	72.16	7.22	64.94	x	0.28	=	18.18			(29)
Walls Type2	33.65	8.43	25.22	x	0.28	=	7.06			(29)
Walls Type3	42.17	3.78	38.39	x	0.22	=	8.59			(29)
Walls Type4	6.26	0	6.26	x	0.22	=	1.4			(29)
Roof	4.84	0.82	4.02	x	0.18	=	0.72			(30)
Total area of elements, m²			204.789							(31)

** 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) = 76.53 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	8478.6729	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(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		30.72	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	107.25	(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=	60.89	58.77	58.77	54.88	52.56	51.48	50.46	50.46	53.12	54.88	56.77	58.77	(38)

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

(39)m=	168.14	166.02	166.02	162.13	159.81	158.73	157.71	157.71	160.37	162.13	164.01	166.02	

Average = Sum(39)1…12 /12= 162.4 (39)

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

(40)m=	1.95	1.93	1.93	1.88	1.85	1.84	1.83	1.83	1.86	1.88	1.9	1.93	

Average = Sum(40)1…12 /12= 1.88 (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 2.57 (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 95.25 (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=	104.77	100.96	97.15	93.34	89.53	85.72	85.72	89.53	93.34	97.15	100.96	104.77	

Total = Sum(44)1…12 = 1142.95 (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=	155.74	136.21	140.56	122.54	117.58	101.47	94.02	107.89	109.18	127.24	138.89	150.83	

Total = Sum(45)1…12 = 1502.18 (45)

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

(46)m=	23.36	20.43	21.08	18.38	17.64	15.22	14.1	16.18	16.38	19.09	20.83	22.62	(46)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day):		0	(47)
Temperature factor from Table 2b		0	(48)
Energy lost from water storage, kWh/year	(47) x (48) =	0	(49)

If manufacturer’s declared cylinder loss factor is not known:

Cylinder volume (litres) including any solar storage within same	150	(50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	0.93	(52)
Temperature factor from Table 2b	0.6	(53)

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Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 1.6 (54)

Enter (49) or (54) in (55) 1.6 (55)

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

(56)m=	49.48	44.69	49.48	47.88	49.48	47.88	49.48	49.48	47.88	49.48	47.88	49.48	(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=	49.48	44.69	49.48	47.88	49.48	47.88	49.48	49.48	47.88	49.48	47.88	49.48	(57)

Primary circuit loss (annual) from Table 3 610 (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=	51.81	46.79	51.81	50.14	51.81	50.14	51.81	51.81	50.14	51.81	50.14	51.81	(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=	257.03	227.7	241.85	220.56	218.87	199.48	195.31	209.18	207.2	228.53	236.91	252.11	(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=	257.03	227.7	241.85	220.56	218.87	199.48	195.31	209.18	207.2	228.53	236.91	252.11

Output from water heater (annual)$_{1...12}$ 2694.72 (64)

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

(65)m=	132.81	118.48	127.76	119.16	120.12	112.15	112.29	116.9	114.72	123.33	124.6	131.18	(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=	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	154.22	(66)

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

(67)m=	64.75	57.51	46.77	35.41	26.47	22.35	24.15	31.39	42.13	53.49	62.43	66.55	(67)

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

(68)m=	346.19	349.79	340.73	321.46	297.13	274.27	258.99	255.4	264.45	283.73	308.05	330.92	(68)

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

(69)m=	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	52.99	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	-102.81	(71)

Water heating gains (Table 5)

(72)m=	178.51	176.31	171.73	165.5	161.46	155.77	150.93	157.13	159.33	165.77	173.05	176.31	(72)

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

(73)m=	703.85	698	673.63	636.77	599.46	566.78	548.47	558.31	580.31	617.39	657.93	688.18	(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)	
Southeast	0.9x	0.54	x	1.29	x	37.39	x	0.76	x	0.7	=	24.94	(77)
Southeast	0.9x	0.54	x	2.32	x	37.39	x	0.76	x	0.7	=	44.85	(77)
Southeast	0.9x	0.54	x	1.29	x	63.74	x	0.76	x	0.7	=	42.52	(77)
Southeast	0.9x	0.54	x	2.32	x	63.74	x	0.76	x	0.7	=	76.46	(77)
Southeast	0.9x	0.54	x	1.29	x	84.22	x	0.76	x	0.7	=	56.18	(77)
Southeast	0.9x	0.54	x	2.32	x	84.22	x	0.76	x	0.7	=	101.03	(77)
Southeast	0.9x	0.54	x	1.29	x	103.49	x	0.76	x	0.7	=	69.03	(77)
Southeast	0.9x	0.54	x	2.32	x	103.49	x	0.76	x	0.7	=	124.15	(77)
Southeast	0.9x	0.54	x	1.29	x	113.34	x	0.76	x	0.7	=	75.6	(77)
Southeast	0.9x	0.54	x	2.32	x	113.34	x	0.76	x	0.7	=	135.97	(77)
Southeast	0.9x	0.54	x	1.29	x	115.04	x	0.76	x	0.7	=	76.74	(77)
Southeast	0.9x	0.54	x	2.32	x	115.04	x	0.76	x	0.7	=	138.02	(77)
Southeast	0.9x	0.54	x	1.29	x	112.79	x	0.76	x	0.7	=	75.24	(77)
Southeast	0.9x	0.54	x	2.32	x	112.79	x	0.76	x	0.7	=	135.31	(77)
Southeast	0.9x	0.54	x	1.29	x	105.34	x	0.76	x	0.7	=	70.27	(77)
Southeast	0.9x	0.54	x	2.32	x	105.34	x	0.76	x	0.7	=	126.38	(77)
Southeast	0.9x	0.54	x	1.29	x	92.9	x	0.76	x	0.7	=	61.97	(77)
Southeast	0.9x	0.54	x	2.32	x	92.9	x	0.76	x	0.7	=	111.45	(77)
Southeast	0.9x	0.54	x	1.29	x	72.36	x	0.76	x	0.7	=	48.27	(77)
Southeast	0.9x	0.54	x	2.32	x	72.36	x	0.76	x	0.7	=	86.81	(77)
Southeast	0.9x	0.54	x	1.29	x	44.83	x	0.76	x	0.7	=	29.9	(77)
Southeast	0.9x	0.54	x	2.32	x	44.83	x	0.76	x	0.7	=	53.78	(77)
Southeast	0.9x	0.54	x	1.29	x	31.95	x	0.76	x	0.7	=	21.31	(77)
Southeast	0.9x	0.54	x	2.32	x	31.95	x	0.76	x	0.7	=	38.33	(77)
Northwest	0.9x	0.54	x	2.39	x	11.51	x	0.63	x	0.7	=	5.9	(81)
Northwest	0.9x	0.54	x	3.82	x	11.51	x	0.63	x	0.7	=	9.42	(81)
Northwest	0.9x	0.54	x	1.61	x	11.51	x	0.63	x	0.7	=	3.97	(81)
Northwest	0.9x	0.54	x	0.61	x	11.51	x	0.63	x	0.7	=	1.5	(81)
Northwest	0.9x	0.54	x	2.39	x	23.55	x	0.63	x	0.7	=	12.07	(81)
Northwest	0.9x	0.54	x	3.82	x	23.55	x	0.63	x	0.7	=	19.28	(81)
Northwest	0.9x	0.54	x	1.61	x	23.55	x	0.63	x	0.7	=	8.13	(81)
Northwest	0.9x	0.54	x	0.61	x	23.55	x	0.63	x	0.7	=	3.08	(81)
Northwest	0.9x	0.54	x	2.39	x	41.13	x	0.63	x	0.7	=	21.07	(81)
Northwest	0.9x	0.54	x	3.82	x	41.13	x	0.63	x	0.7	=	33.67	(81)
Northwest	0.9x	0.54	x	1.61	x	41.13	x	0.63	x	0.7	=	14.19	(81)
Northwest	0.9x	0.54	x	0.61	x	41.13	x	0.63	x	0.7	=	5.38	(81)
Northwest	0.9x	0.54	x	2.39	x	67.8	x	0.63	x	0.7	=	34.73	(81)
Northwest	0.9x	0.54	x	3.82	x	67.8	x	0.63	x	0.7	=	55.51	(81)
Northwest	0.9x	0.54	x	1.61	x	67.8	x	0.63	x	0.7	=	23.39	(81)

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Northwest	0.9x	0.54	x	0.61	x	67.8	x	0.63	x	0.7	=	8.86	(81)
Northwest	0.9x	0.54	x	2.39	x	89.77	x	0.63	x	0.7	=	45.98	(81)
Northwest	0.9x	0.54	x	3.82	x	89.77	x	0.63	x	0.7	=	73.49	(81)
Northwest	0.9x	0.54	x	1.61	x	89.77	x	0.63	x	0.7	=	30.98	(81)
Northwest	0.9x	0.54	x	0.61	x	89.77	x	0.63	x	0.7	=	11.74	(81)
Northwest	0.9x	0.54	x	2.39	x	97.5	x	0.63	x	0.7	=	49.94	(81)
Northwest	0.9x	0.54	x	3.82	x	97.5	x	0.63	x	0.7	=	79.83	(81)
Northwest	0.9x	0.54	x	1.61	x	97.5	x	0.63	x	0.7	=	33.64	(81)
Northwest	0.9x	0.54	x	0.61	x	97.5	x	0.63	x	0.7	=	12.75	(81)
Northwest	0.9x	0.54	x	2.39	x	92.98	x	0.63	x	0.7	=	47.63	(81)
Northwest	0.9x	0.54	x	3.82	x	92.98	x	0.63	x	0.7	=	76.12	(81)
Northwest	0.9x	0.54	x	1.61	x	92.98	x	0.63	x	0.7	=	32.08	(81)
Northwest	0.9x	0.54	x	0.61	x	92.98	x	0.63	x	0.7	=	12.16	(81)
Northwest	0.9x	0.54	x	2.39	x	75.42	x	0.63	x	0.7	=	38.63	(81)
Northwest	0.9x	0.54	x	3.82	x	75.42	x	0.63	x	0.7	=	61.75	(81)
Northwest	0.9x	0.54	x	1.61	x	75.42	x	0.63	x	0.7	=	26.02	(81)
Northwest	0.9x	0.54	x	0.61	x	75.42	x	0.63	x	0.7	=	9.86	(81)
Northwest	0.9x	0.54	x	2.39	x	51.24	x	0.63	x	0.7	=	26.25	(81)
Northwest	0.9x	0.54	x	3.82	x	51.24	x	0.63	x	0.7	=	41.96	(81)
Northwest	0.9x	0.54	x	1.61	x	51.24	x	0.63	x	0.7	=	17.68	(81)
Northwest	0.9x	0.54	x	0.61	x	51.24	x	0.63	x	0.7	=	6.7	(81)
Northwest	0.9x	0.54	x	2.39	x	29.6	x	0.63	x	0.7	=	15.16	(81)
Northwest	0.9x	0.54	x	3.82	x	29.6	x	0.63	x	0.7	=	24.23	(81)
Northwest	0.9x	0.54	x	1.61	x	29.6	x	0.63	x	0.7	=	10.21	(81)
Northwest	0.9x	0.54	x	0.61	x	29.6	x	0.63	x	0.7	=	3.87	(81)
Northwest	0.9x	0.54	x	2.39	x	14.52	x	0.63	x	0.7	=	7.44	(81)
Northwest	0.9x	0.54	x	3.82	x	14.52	x	0.63	x	0.7	=	11.89	(81)
Northwest	0.9x	0.54	x	1.61	x	14.52	x	0.63	x	0.7	=	5.01	(81)
Northwest	0.9x	0.54	x	0.61	x	14.52	x	0.63	x	0.7	=	1.9	(81)
Northwest	0.9x	0.54	x	2.39	x	9.36	x	0.63	x	0.7	=	4.79	(81)
Northwest	0.9x	0.54	x	3.82	x	9.36	x	0.63	x	0.7	=	7.66	(81)
Northwest	0.9x	0.54	x	1.61	x	9.36	x	0.63	x	0.7	=	3.23	(81)
Northwest	0.9x	0.54	x	0.61	x	9.36	x	0.63	x	0.7	=	1.22	(81)
Rooflights	0.9x	1	x	0.41	x	26	x	0.63	x	0.8	=	9.67	(82)
Rooflights	0.9x	1	x	0.41	x	54	x	0.63	x	0.8	=	20.09	(82)
Rooflights	0.9x	1	x	0.41	x	94	x	0.63	x	0.8	=	34.96	(82)
Rooflights	0.9x	1	x	0.41	x	150	x	0.63	x	0.8	=	55.79	(82)
Rooflights	0.9x	1	x	0.41	x	190	x	0.63	x	0.8	=	70.67	(82)
Rooflights	0.9x	1	x	0.41	x	201	x	0.63	x	0.8	=	74.76	(82)
Rooflights	0.9x	1	x	0.41	x	194	x	0.63	x	0.8	=	72.16	(82)
Rooflights	0.9x	1	x	0.41	x	164	x	0.63	x	0.8	=	61	(82)

Rooflights	0.9x	1	x	0.41	x	116	x	0.63	x	0.8	=	43.15	(82)
Rooflights	0.9x	1	x	0.41	x	68	x	0.63	x	0.8	=	25.29	(82)
Rooflights	0.9x	1	x	0.41	x	33	x	0.63	x	0.8	=	12.27	(82)
Rooflights	0.9x	1	x	0.41	x	21	x	0.63	x	0.8	=	7.81	(82)

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

(83)m=	100.26	181.62	266.48	371.48	444.43	465.68	450.7	393.91	309.15	213.85	122.2	84.37	(83)

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

(84)m=	804.11	879.62	940.11	1008.24	1043.89	1032.46	999.17	952.22	889.46	831.24	780.13	772.55	(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=	0.93	0.92	0.89	0.85	0.78	0.66	0.52	0.53	0.73	0.85	0.92	0.94	(86)

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

(87)m=	17.73	17.99	18.53	19.13	19.87	20.44	20.78	20.77	20.29	19.44	18.41	17.82	(87)

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

(88)m=	19.37	19.39	19.39	19.42	19.44	19.45	19.46	19.46	19.43	19.42	19.41	19.39	(88)

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

(89)m=	0.92	0.91	0.87	0.82	0.72	0.57	0.36	0.38	0.64	0.82	0.9	0.92	(89)

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

(90)m=	16.53	16.79	17.32	17.92	18.63	19.14	19.39	19.38	19.01	18.23	17.22	16.63	(90)

fLA = Living area ÷ (4) = 0.22 (91)

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

(92)m=	16.79	17.05	17.58	18.18	18.9	19.42	19.69	19.68	19.29	18.49	17.48	16.89	(92)

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

(93)m=	16.79	17.05	17.58	18.18	18.9	19.42	19.69	19.68	19.29	18.49	17.48	16.89	(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=	0.9	0.88	0.84	0.79	0.7	0.56	0.39	0.4	0.63	0.79	0.87	0.9	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	720.93	771.88	791.91	798.45	729.19	582.28	388.24	383.63	560.68	654.83	681.01	693.95	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2065.77	2001.01	1789.98	1537.17	1150.97	765.29	439.82	438.69	800.1	1247.59	1718.38	1990.44	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1000.56	825.98	742.56	531.88	313.8	0	0	0	0	441.02	746.91	964.59	

Total per year (kWh/year) = $Sum(98)_{1…5,9…12}$ = 5567.3 (98)

Space heating requirement in kWh/m²/year 64.57 (99)

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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		78.9	(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)	1000.56	825.98	742.56	531.88	313.8	0	0	0	0	441.02	746.91	964.59		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	1268.13	1046.87	941.14	674.12	397.72	0	0	0	0	558.96	946.65	1222.55		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													7056.15	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)	257.03	227.7	241.85	220.56	218.87	199.48	195.31	209.18	207.2	228.53	236.91	252.11		
Efficiency of water heater													68.8	(216)
(217)m=	76.6	76.47	76.15	75.64	74.41	68.8	68.8	68.8	68.8	75.14	76.21	76.57		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	335.54	297.74	317.58	291.57	294.13	289.95	283.88	304.04	301.16	304.15	310.88	329.26		
Total = Sum(219a)$_{1...12}$ =													3659.88	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			7056.15	
Water heating fuel used			3659.88	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			457.41	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	218.7405	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	113.46	(247)

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Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	52.42	(250)
Additional standing charges (Table 12)				106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	510.6706	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.8291	(257)
SAP rating (Section 12)		74.484	(258)

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	0.198	=	1397.12	(261)
Space heating (secondary)	(215)	x	0	=	0	(263)
Water heating	(219)	x	0.198	=	724.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2121.77	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.517	=	90.48	(267)
Electricity for lighting	(232)	x	0.517	=	236.48	(268)
Total CO2, kg/year			sum of (265)…(271) =		2448.73	(272)
CO2 emissions per m²			(272) ÷ (4) =		28.4	(273)
EI rating (section 14)					75	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.02	=	7197.27	(261)
Space heating (secondary)	(215)	x	0	=	0	(263)
Energy for water heating	(219)	x	1.02	=	3733.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =				10930.34	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	2.92	=	511	(267)
Electricity for lighting	(232)	x	0	=	1335.63	(268)
'Total Primary Energy			sum of (265)…(271) =		12776.97	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		148.19	(273)

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User Details:

Assessor Name:	Test User	**Stroma Number:**	STRO000000
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.74

Property Address: First floor flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	43.02	(1a) x	3.67	(2a) =	157.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	43.02	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	157.88	(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) =	0.13	(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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.63	(18)

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

Number of sides on which sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.63	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.85	0.8	0.8	0.7	0.64	0.61	0.58	0.58	0.66	0.7	0.75	0.8

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=	0.86	0.82	0.82	0.75	0.71	0.69	0.67	0.67	0.72	0.75	0.78	0.82	(24d)

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

(25)m=	0.86	0.82	0.82	0.75	0.71	0.69	0.67	0.67	0.72	0.75	0.78	0.82	(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			1.93	x1/[1/(2.4)+ 0.04]	=	4.23			(27)
Windows Type 2			1.65	x1/[1/(1.2)+ 0.04]	=	1.89			(27)
Windows Type 3			1.74	x1/[1/(1.2)+ 0.04]	=	1.99			(27)
Walls Type1	79.46	7.25	72.21	x 0.17	=	12.28			(29)
Walls Type2	10.96	0	10.96	x 0.24	=	2.59			(29)
Walls Type3	12.32	0	12.32	x 0.39	=	4.8			(29)
Total area of elements, m²			102.742						(31)

** 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) = 32 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1056.619 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 15.41 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 47.41 (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=	44.7	42.68	42.68	39	36.8	35.78	34.8	34.8	37.33	39	40.78	42.68	(38)

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

(39)m=	92.11	90.09	90.09	86.41	84.21	83.19	82.21	82.21	84.74	86.41	88.19	90.09	

Average = Sum(39)1…12 /12= 86.66 (39)

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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=	2.14	2.09	2.09	2.01	1.96	1.93	1.91	1.91	1.97	2.01	2.05	2.09		
										Average = Sum(40)$_{1…12}$ /12=			2.01	(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 — 1.49 (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 — 73.22 (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=	80.54	77.61	74.68	71.75	68.82	65.9	65.9	68.82	71.75	74.68	77.61	80.54		
										Total = Sum(44)$_{1…12}$ =			878.61	(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=	119.72	104.71	108.05	94.2	90.39	78	72.28	82.94	83.93	97.81	106.77	115.95		
										Total = Sum(45)$_{1…12}$ =			1154.76	(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=	17.96	15.71	16.21	14.13	13.56	11.7	10.84	12.44	12.59	14.67	16.02	17.39	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(47)
Temperature factor from Table 2b		0	(48)
Energy lost from water storage, kWh/year	(47) x (48) =	0	(49)
If manufacturer's declared cylinder loss factor is not known:			
Cylinder volume (litres) including any solar storage within same		0	(50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	((50) x (51) x (52) x (53) =	0	(54)
Enter (49) or (54) in (55)		0	(55)

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	41.04	35.72	38.06	35.39	35.07	32.5	33.58	35.07	35.39	38.06	38.27	41.04	(61)

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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=	160.77	140.43	146.11	129.59	125.46	110.5	105.86	118.01	119.32	135.87	145.04	156.99	(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=	160.77	140.43	146.11	129.59	125.46	110.5	105.86	118.01	119.32	135.87	145.04	156.99	

Output from water heater (annual)$_{1...12}$ 1593.95 (64)

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

(65)m=	50.07	43.75	45.44	40.17	38.82	34.06	32.43	36.35	36.75	42.04	45.07	48.81	(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=	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	(66)

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

(67)m=	35.69	31.7	25.78	19.52	14.59	12.32	13.31	17.3	23.22	29.49	34.41	36.69	(67)

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

(68)m=	192.83	194.83	189.79	179.05	165.5	152.77	144.26	142.26	147.3	158.04	171.59	184.32	(68)

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

(69)m=	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	(71)

Water heating gains (Table 5)

(72)m=	67.3	65.1	61.08	55.79	52.18	47.3	43.59	48.85	51.05	56.5	62.6	65.61	(72)

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

(73)m=	381.02	376.83	361.85	339.56	317.47	297.59	286.35	293.61	306.76	329.22	353.79	371.81	(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	1.93	x	37.39	x	0.76	x	0.7	=	53.21	(77)
Southeast 0.9x	0.77	x	1.93	x	63.74	x	0.76	x	0.7	=	90.7	(77)
Southeast 0.9x	0.77	x	1.93	x	84.22	x	0.76	x	0.7	=	119.85	(77)
Southeast 0.9x	0.77	x	1.93	x	103.49	x	0.76	x	0.7	=	147.27	(77)
Southeast 0.9x	0.77	x	1.93	x	113.34	x	0.76	x	0.7	=	161.29	(77)
Southeast 0.9x	0.77	x	1.93	x	115.04	x	0.76	x	0.7	=	163.72	(77)
Southeast 0.9x	0.77	x	1.93	x	112.79	x	0.76	x	0.7	=	160.51	(77)
Southeast 0.9x	0.77	x	1.93	x	105.34	x	0.76	x	0.7	=	149.91	(77)

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Southeast	0.9x	0.77	x	1.93	x	92.9	x	0.76	x	0.7	=	132.2	(77)
Southeast	0.9x	0.77	x	1.93	x	72.36	x	0.76	x	0.7	=	102.98	(77)
Southeast	0.9x	0.77	x	1.93	x	44.83	x	0.76	x	0.7	=	63.79	(77)
Southeast	0.9x	0.77	x	1.93	x	31.95	x	0.76	x	0.7	=	45.47	(77)
Northwest	0.9x	0.77	x	1.65	x	11.51	x	0.63	x	0.7	=	5.8	(81)
Northwest	0.9x	0.77	x	1.74	x	11.51	x	0.63	x	0.7	=	6.12	(81)
Northwest	0.9x	0.77	x	1.65	x	23.55	x	0.63	x	0.7	=	11.88	(81)
Northwest	0.9x	0.77	x	1.74	x	23.55	x	0.63	x	0.7	=	12.53	(81)
Northwest	0.9x	0.77	x	1.65	x	41.13	x	0.63	x	0.7	=	20.74	(81)
Northwest	0.9x	0.77	x	1.74	x	41.13	x	0.63	x	0.7	=	21.87	(81)
Northwest	0.9x	0.77	x	1.65	x	67.8	x	0.63	x	0.7	=	34.19	(81)
Northwest	0.9x	0.77	x	1.74	x	67.8	x	0.63	x	0.7	=	36.05	(81)
Northwest	0.9x	0.77	x	1.65	x	89.77	x	0.63	x	0.7	=	45.27	(81)
Northwest	0.9x	0.77	x	1.74	x	89.77	x	0.63	x	0.7	=	47.73	(81)
Northwest	0.9x	0.77	x	1.65	x	97.5	x	0.63	x	0.7	=	49.17	(81)
Northwest	0.9x	0.77	x	1.74	x	97.5	x	0.63	x	0.7	=	51.85	(81)
Northwest	0.9x	0.77	x	1.65	x	92.98	x	0.63	x	0.7	=	46.89	(81)
Northwest	0.9x	0.77	x	1.74	x	92.98	x	0.63	x	0.7	=	49.44	(81)
Northwest	0.9x	0.77	x	1.65	x	75.42	x	0.63	x	0.7	=	38.03	(81)
Northwest	0.9x	0.77	x	1.74	x	75.42	x	0.63	x	0.7	=	40.1	(81)
Northwest	0.9x	0.77	x	1.65	x	51.24	x	0.63	x	0.7	=	25.84	(81)
Northwest	0.9x	0.77	x	1.74	x	51.24	x	0.63	x	0.7	=	27.25	(81)
Northwest	0.9x	0.77	x	1.65	x	29.6	x	0.63	x	0.7	=	14.93	(81)
Northwest	0.9x	0.77	x	1.74	x	29.6	x	0.63	x	0.7	=	15.74	(81)
Northwest	0.9x	0.77	x	1.65	x	14.52	x	0.63	x	0.7	=	7.32	(81)
Northwest	0.9x	0.77	x	1.74	x	14.52	x	0.63	x	0.7	=	7.72	(81)
Northwest	0.9x	0.77	x	1.65	x	9.36	x	0.63	x	0.7	=	4.72	(81)
Northwest	0.9x	0.77	x	1.74	x	9.36	x	0.63	x	0.7	=	4.98	(81)

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

(83)m=	65.13	115.1	162.46	217.51	254.29	264.73	256.84	228.04	185.29	133.64	78.84	55.17	(83)

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

(84)m=	446.15	491.93	524.3	557.07	571.76	562.32	543.19	521.65	492.06	462.86	432.63	426.98	(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=	0.93	0.91	0.88	0.84	0.76	0.64	0.5	0.51	0.71	0.84	0.91	0.93	(86)

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

(87)m=	17.6	17.9	18.45	19.1	19.87	20.44	20.78	20.77	20.29	19.42	18.34	17.72	(87)

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

(88)m=	19.25	19.28	19.28	19.33	19.37	19.38	19.4	19.4	19.36	19.33	19.31	19.28	(88)

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

(89)m=	0.91	0.89	0.86	0.8	0.7	0.54	0.34	0.35	0.61	0.8	0.89	0.91	(89)

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

(90)m=	16.32	16.64	17.18	17.83	18.57	19.08	19.33	19.33	18.95	18.16	17.1	16.46	(90)

fLA = Living area ÷ (4) = 0.46 (91)

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

(92)m=	16.91	17.22	17.77	18.42	19.17	19.71	20	20	19.57	18.74	17.67	17.04	(92)

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

(93)m=	16.91	17.22	17.77	18.42	19.17	19.71	20	20	19.57	18.74	17.67	17.04	(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=	0.89	0.87	0.83	0.78	0.69	0.57	0.41	0.42	0.63	0.78	0.86	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	395.71	425.85	435.46	435.08	395.46	318.61	221.02	218.58	308.73	359.48	373.17	379.61	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1143.39	1101.3	988.14	839.67	629.18	425.31	255.23	254.61	446.55	686.33	941.29	1093.77	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	556.28	453.9	411.19	291.3	173.89	0	0	0	0	243.18	409.05	531.34	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3070.13 (98)

Space heating requirement in kWh/m²/year 71.37 (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 92.6 (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)													
	556.28	453.9	411.19	291.3	173.89	0	0	0	0	243.18	409.05	531.34	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	600.73	490.17	444.05	314.58	187.79	0	0	0	0	262.61	441.74	573.8	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3315.47 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } 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)

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Water heating

Output from water heater (calculated above)

	160.77	140.43	146.11	129.59	125.46	110.5	105.86	118.01	119.32	135.87	145.04	156.99	
Efficiency of water heater													79.5 (216)
(217)m=	87.12	86.99	86.71	86.23	85.07	79.5	79.5	79.5	79.5	85.7	86.72	87.08	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	184.54	161.44	168.5	150.29	147.48	138.99	133.15	148.44	150.08	158.55	167.26	180.29

Total = Sum(219a)$_{1...12}$ = 1889.01 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3315.47	
Water heating fuel used		1889.01	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	130		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		175	(231)
Electricity for lighting		252.15	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	102.7797	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	58.56	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	28.9	(250)
Additional standing charges (Table 12)				106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 316.2903 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.6889	(257)
SAP rating (Section 12)		76.4399	(258)

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	0.198	=	656.46	(261)

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Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	374.02	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1030.49	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	130.36	(268)
Total CO2, kg/year		sum of (265)…(271) =		1251.32	(272)
CO2 emissions per m²		(272) ÷ (4) =		29.09	(273)
EI rating (section 14)				81	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.02	=	3381.78	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	1926.79	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5308.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	736.27	(268)
'Total Primary Energy		sum of (265)…(271) =		6555.85	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		152.39	(273)

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User Details:

Assessor Name:	Test User	**Stroma Number:**	STRO000000
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.74

Property Address: First floor existing

Address :

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)			Volume(m³)	
Ground floor	43.02	(1a) x	3.67	(2a)	=	157.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	43.02	(4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			157.88	(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) =	0.13	(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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.63	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides on which sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.63	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.85	0.8	0.8	0.7	0.64	0.61	0.58	0.58	0.66	0.7	0.75	0.8

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=	0.86	0.82	0.82	0.75	0.71	0.69	0.67	0.67	0.72	0.75	0.78	0.82	(24d)

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

(25)m=	0.86	0.82	0.82	0.75	0.71	0.69	0.67	0.67	0.72	0.75	0.78	0.82	(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			1.93	x1/[1/(1.6)+ 0.04]	=	2.9			(27)
Windows Type 2			1.65	x1/[1/(1.6)+ 0.04]	=	2.48			(27)
Windows Type 3			1.74	x1/[1/(1.6)+ 0.04]	=	2.62			(27)
Walls Type1	79.46	7.25	72.21	x 0.28	=	20.22			(29)
Walls Type2	10.96	0	10.96	x 0.22	=	2.45			(29)
Walls Type3	12.32	0	12.32	x 0.22	=	2.76			(29)
Total area of elements, m²			102.742						(31)

** 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) = 36.33 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1056.619 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 15.41 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 51.74 (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=	44.7	42.68	42.68	39	36.8	35.78	34.8	34.8	37.33	39	40.78	42.68	(38)

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

(39)m=	96.44	94.42	94.42	90.74	88.54	87.52	86.54	86.54	89.07	90.74	92.52	94.42	

Average = Sum(39)1…12 /12= 90.99 (39)

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

(40)m=	2.24	2.19	2.19	2.11	2.06	2.03	2.01	2.01	2.07	2.11	2.15	2.19	

Average = Sum(40)1…12 /12= 2.12 (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 1.49 (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 73.22 (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=	80.54	77.61	74.68	71.75	68.82	65.9	65.9	68.82	71.75	74.68	77.61	80.54	

Total = Sum(44)1…12 = 878.61 (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=	119.72	104.71	108.05	94.2	90.39	78	72.28	82.94	83.93	97.81	106.77	115.95	

Total = Sum(45)1…12 = 1154.76 (45)

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

(46)m=	17.96	15.71	16.21	14.13	13.56	11.7	10.84	12.44	12.59	14.67	16.02	17.39	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 150 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 1.6 (54)

Enter (49) or (54) in (55) 1.6 (55)

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

(56)m=	49.48	44.69	49.48	47.88	49.48	47.88	49.48	49.48	47.88	49.48	47.88	49.48	(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=	49.48	44.69	49.48	47.88	49.48	47.88	49.48	49.48	47.88	49.48	47.88	49.48	(57)

Primary circuit loss (annual) from Table 3 610 (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=	51.81	46.79	51.81	50.14	51.81	50.14	51.81	51.81	50.14	51.81	50.14	51.81	(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)

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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=	221.01	196.19	209.34	192.22	191.67	176.02	173.56	184.22	181.95	199.1	204.79	217.23	(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=	221.01	196.19	209.34	192.22	191.67	176.02	173.56	184.22	181.95	199.1	204.79	217.23	

Output from water heater (annual)1…12 2347.3 (64)

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

(65)m=	120.84	108	116.95	109.74	111.08	104.35	105.06	108.6	106.32	113.55	113.91	119.58	(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):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	89.32	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	35.69	31.7	25.78	19.52	14.59	12.32	13.31	17.3	23.22	29.49	34.41	36.69	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	192.83	194.83	189.79	179.05	165.5	152.77	144.26	142.26	147.3	158.04	171.59	184.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	45.42	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	-59.55	(71)
Water heating gains (Table 5)													
(72)m=	162.41	160.72	157.2	152.41	149.3	144.93	141.21	145.97	147.67	152.62	158.21	160.72	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	476.13	472.45	457.96	436.18	414.59	395.21	383.98	390.73	403.39	425.34	449.41	466.93	(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	1.93	x	37.39	x	0.76	x	0.7	=	53.21	(77)
Southeast	0.9x	0.77	x	1.93	x	63.74	x	0.76	x	0.7	=	90.7	(77)
Southeast	0.9x	0.77	x	1.93	x	84.22	x	0.76	x	0.7	=	119.85	(77)
Southeast	0.9x	0.77	x	1.93	x	103.49	x	0.76	x	0.7	=	147.27	(77)
Southeast	0.9x	0.77	x	1.93	x	113.34	x	0.76	x	0.7	=	161.29	(77)
Southeast	0.9x	0.77	x	1.93	x	115.04	x	0.76	x	0.7	=	163.72	(77)
Southeast	0.9x	0.77	x	1.93	x	112.79	x	0.76	x	0.7	=	160.51	(77)
Southeast	0.9x	0.77	x	1.93	x	105.34	x	0.76	x	0.7	=	149.91	(77)

Southeast 0.9x	0.77	x	1.93	x	92.9	x	0.76	x	0.7	=	132.2	(77)
Southeast 0.9x	0.77	x	1.93	x	72.36	x	0.76	x	0.7	=	102.98	(77)
Southeast 0.9x	0.77	x	1.93	x	44.83	x	0.76	x	0.7	=	63.79	(77)
Southeast 0.9x	0.77	x	1.93	x	31.95	x	0.76	x	0.7	=	45.47	(77)
Northwest 0.9x	0.77	x	1.65	x	11.51	x	0.63	x	0.7	=	5.8	(81)
Northwest 0.9x	0.77	x	1.74	x	11.51	x	0.63	x	0.7	=	6.12	(81)
Northwest 0.9x	0.77	x	1.65	x	23.55	x	0.63	x	0.7	=	11.88	(81)
Northwest 0.9x	0.77	x	1.74	x	23.55	x	0.63	x	0.7	=	12.53	(81)
Northwest 0.9x	0.77	x	1.65	x	41.13	x	0.63	x	0.7	=	20.74	(81)
Northwest 0.9x	0.77	x	1.74	x	41.13	x	0.63	x	0.7	=	21.87	(81)
Northwest 0.9x	0.77	x	1.65	x	67.8	x	0.63	x	0.7	=	34.19	(81)
Northwest 0.9x	0.77	x	1.74	x	67.8	x	0.63	x	0.7	=	36.05	(81)
Northwest 0.9x	0.77	x	1.65	x	89.77	x	0.63	x	0.7	=	45.27	(81)
Northwest 0.9x	0.77	x	1.74	x	89.77	x	0.63	x	0.7	=	47.73	(81)
Northwest 0.9x	0.77	x	1.65	x	97.5	x	0.63	x	0.7	=	49.17	(81)
Northwest 0.9x	0.77	x	1.74	x	97.5	x	0.63	x	0.7	=	51.85	(81)
Northwest 0.9x	0.77	x	1.65	x	92.98	x	0.63	x	0.7	=	46.89	(81)
Northwest 0.9x	0.77	x	1.74	x	92.98	x	0.63	x	0.7	=	49.44	(81)
Northwest 0.9x	0.77	x	1.65	x	75.42	x	0.63	x	0.7	=	38.03	(81)
Northwest 0.9x	0.77	x	1.74	x	75.42	x	0.63	x	0.7	=	40.1	(81)
Northwest 0.9x	0.77	x	1.65	x	51.24	x	0.63	x	0.7	=	25.84	(81)
Northwest 0.9x	0.77	x	1.74	x	51.24	x	0.63	x	0.7	=	27.25	(81)
Northwest 0.9x	0.77	x	1.65	x	29.6	x	0.63	x	0.7	=	14.93	(81)
Northwest 0.9x	0.77	x	1.74	x	29.6	x	0.63	x	0.7	=	15.74	(81)
Northwest 0.9x	0.77	x	1.65	x	14.52	x	0.63	x	0.7	=	7.32	(81)
Northwest 0.9x	0.77	x	1.74	x	14.52	x	0.63	x	0.7	=	7.72	(81)
Northwest 0.9x	0.77	x	1.65	x	9.36	x	0.63	x	0.7	=	4.72	(81)
Northwest 0.9x	0.77	x	1.74	x	9.36	x	0.63	x	0.7	=	4.98	(81)

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

(83)m=	65.13	115.1	162.46	217.51	254.29	264.73	256.84	228.04	185.29	133.64	78.84	55.17	(83)

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

(84)m=	541.26	587.55	620.42	653.69	668.88	659.94	640.82	618.77	588.68	558.98	528.25	522.09	(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=	0.9	0.88	0.85	0.81	0.72	0.6	0.46	0.47	0.66	0.8	0.88	0.9	(86)

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

(87)m=	17.71	18	18.54	19.17	19.93	20.48	20.8	20.79	20.35	19.52	18.45	17.83	(87)

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

(88)m=	19.88	19.9	19.9	19.95	19.97	19.98	19.99	19.99	19.96	19.95	19.92	19.9	(88)

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

(89)m=	0.89	0.87	0.84	0.78	0.68	0.54	0.37	0.38	0.6	0.77	0.86	0.89	(89)

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

(90)m=	16.89	17.2	17.73	18.37	19.11	19.62	19.89	19.89	19.5	18.71	17.66	17.03	(90)

fLA = Living area ÷ (4) = 0.46 (91)

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

(92)m=	17.27	17.57	18.11	18.74	19.49	20.02	20.31	20.31	19.89	19.08	18.03	17.4	(92)

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

(93)m=	17.27	17.57	18.11	18.74	19.49	20.02	20.31	20.31	19.89	19.08	18.03	17.4	(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=	0.86	0.84	0.8	0.75	0.66	0.54	0.4	0.41	0.6	0.74	0.83	0.86	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	466.3	493.67	498.94	492.85	444.79	359.44	255.27	252.85	352.33	415.71	439.99	450.29	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1231.32	1186.67	1067.62	911.27	689.35	474.46	295.45	294.84	497.79	751.49	1020.22	1179.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	569.17	465.7	423.1	301.26	181.95	0	0	0	0	249.82	417.76	542.84	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3151.61 (98)

Space heating requirement in kWh/m²/year 73.26 (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		78.9	(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)													
	569.17	465.7	423.1	301.26	181.95	0	0	0	0	249.82	417.76	542.84	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	721.39	590.24	536.25	381.82	230.61	0	0	0	0	316.63	529.49	688.01	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 3994.43 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } 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)

SAP WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	221.01	196.19	209.34	192.22	191.67	176.02	173.56	184.22	181.95	199.1	204.79	217.23		
Efficiency of water heater													68.8	(216)
(217)m=	75.79	75.61	75.24	74.63	73.37	68.8	68.8	68.8	68.8	74.08	75.27	75.72		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	291.61	259.48	278.21	257.56	261.23	255.84	252.27	267.77	264.46	268.77	272.09	286.87		
							Total = Sum(219a)$_{1...12}$ =						3216.15	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3994.43	
Water heating fuel used			3216.15	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			252.15	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	123.8274	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	99.7	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	28.9	(250)
Additional standing charges (Table 12)				106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	378.4795	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.021	(257)
SAP rating (Section 12)		71.8075	(258)

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	0.198	=	790.9	(261)

SAP WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	636.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1427.7	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	130.36	(268)
Total CO2, kg/year		sum of (265)…(271) =		1648.53	(272)
CO2 emissions per m²		(272) ÷ (4) =		38.32	(273)
EI rating (section 14)				75	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.02	=	4074.32	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	3280.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7354.8	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	736.27	(268)
‘Total Primary Energy		sum of (265)…(271) =		8602.07	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		199.96	(273)

Predicted Energy Assessment

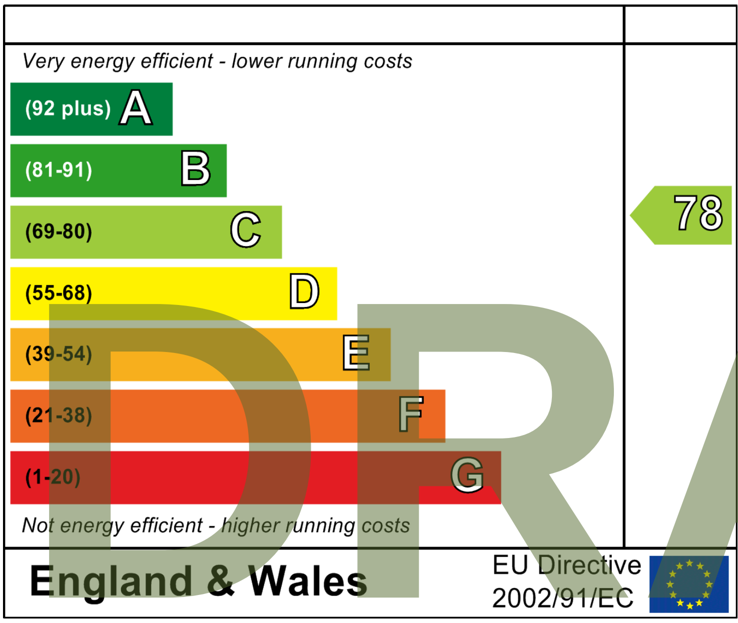
82 Guilford Street
London
WC1N 1DF

Dwelling type: Ground floor Maisonette
Date of assessment: 15 July 2014
Produced by: Stroma Certification
Total floor area: 86.22 m²

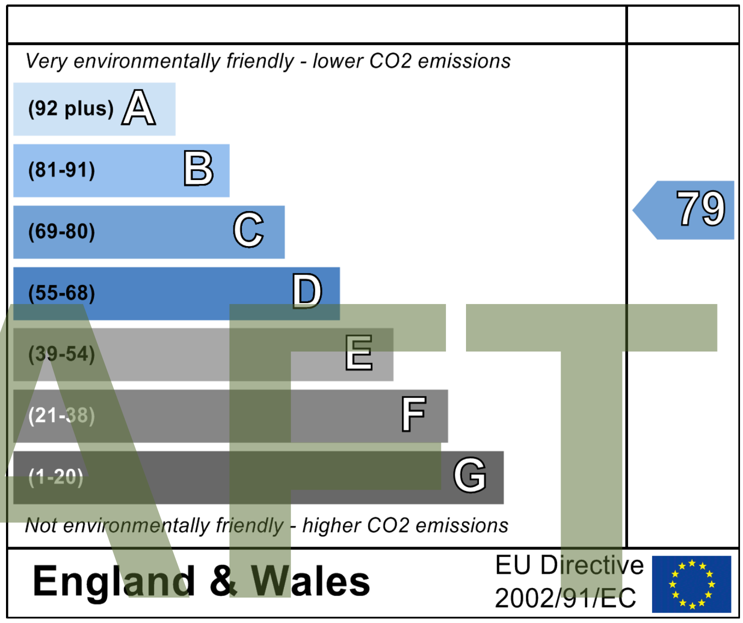
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2009 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

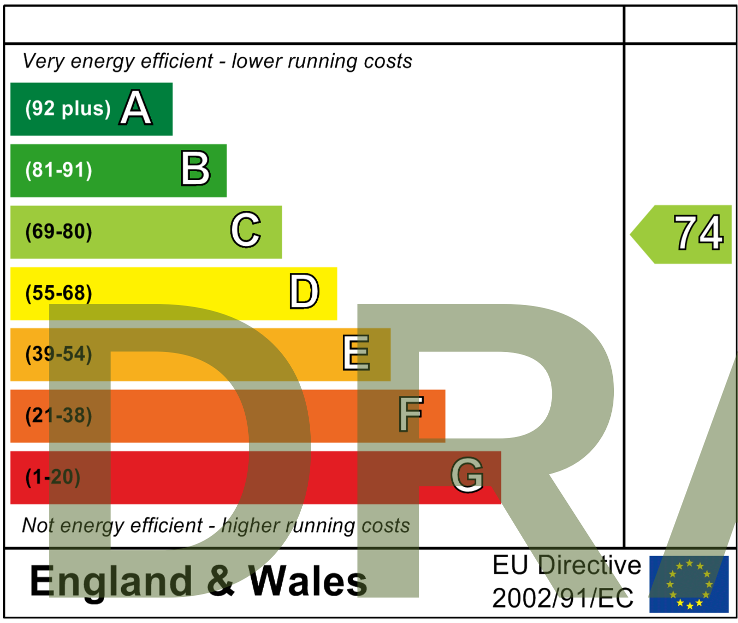
82 Guilford Street
London
WC1N 1DF

Dwelling type:	Ground floor Maisonette
Date of assessment:	15 July 2014
Produced by:	Stroma Certification
Total floor area:	86.22 m²

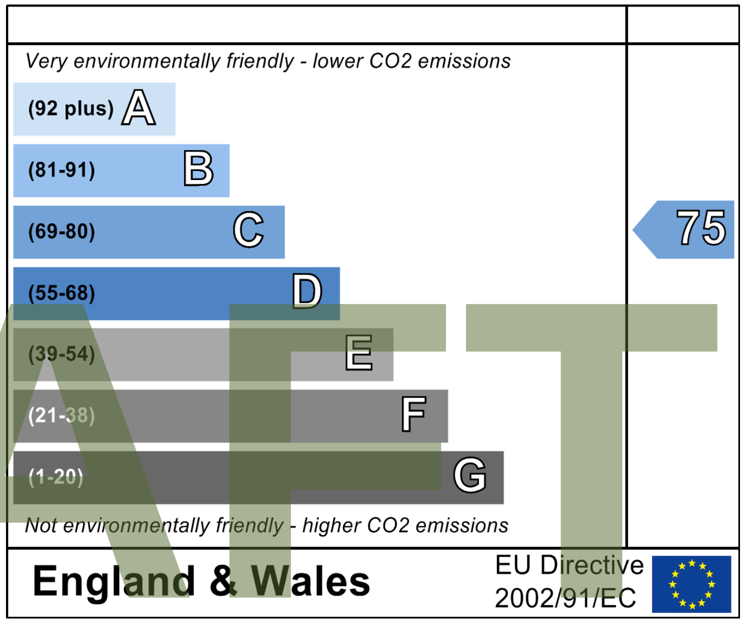
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2009 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

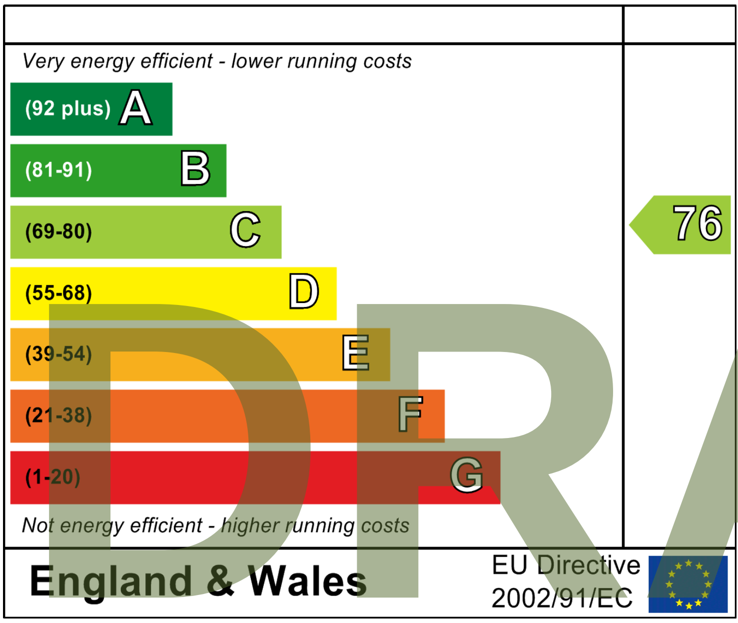
Predicted Energy Assessment

Dwelling type:	Mid floor Flat
Date of assessment:	21 July 2014
Produced by:	Stroma Certification
Total floor area:	43.02 m²

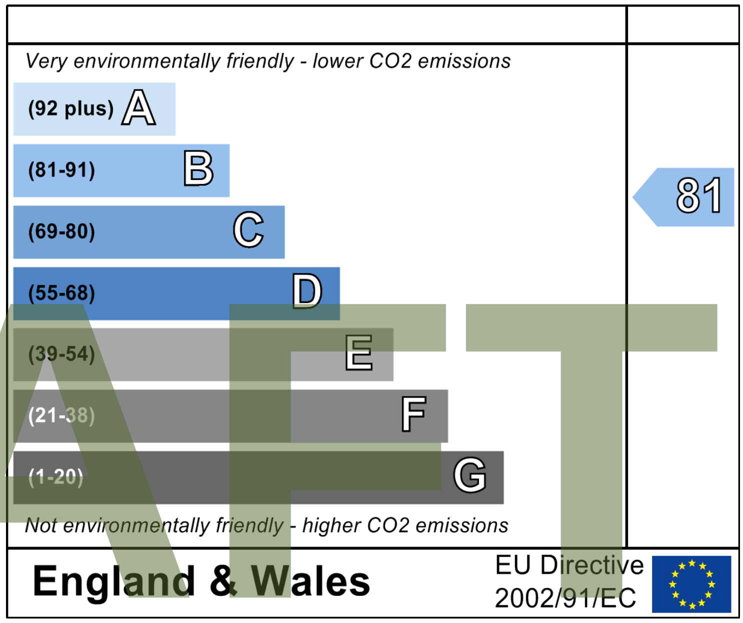
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2009 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

Dwelling type:	Mid floor Flat
Date of assessment:	21 July 2014
Produced by:	Stroma Certification
Total floor area:	43.02 m²

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

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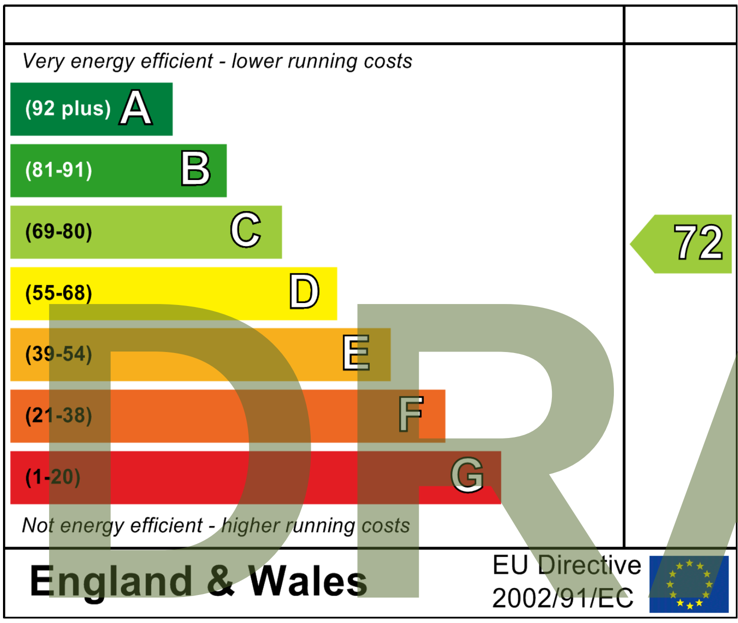
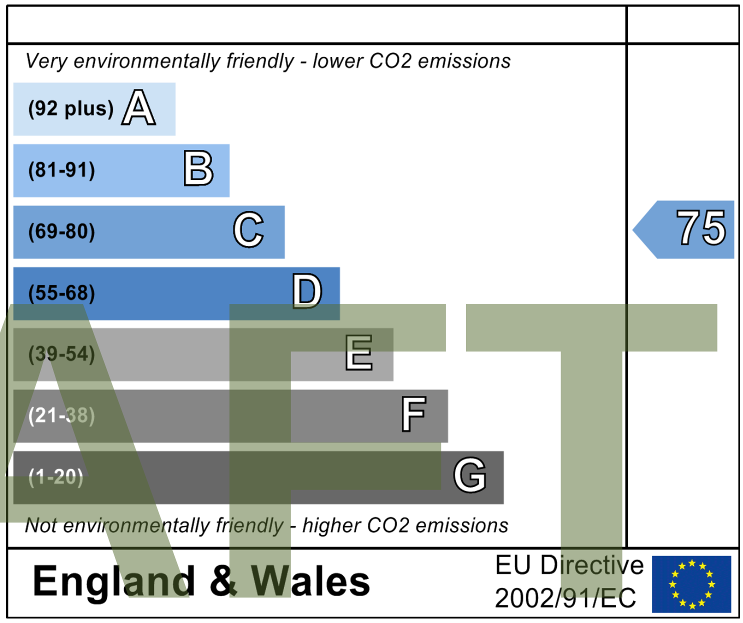
Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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Predicted Energy Assessment

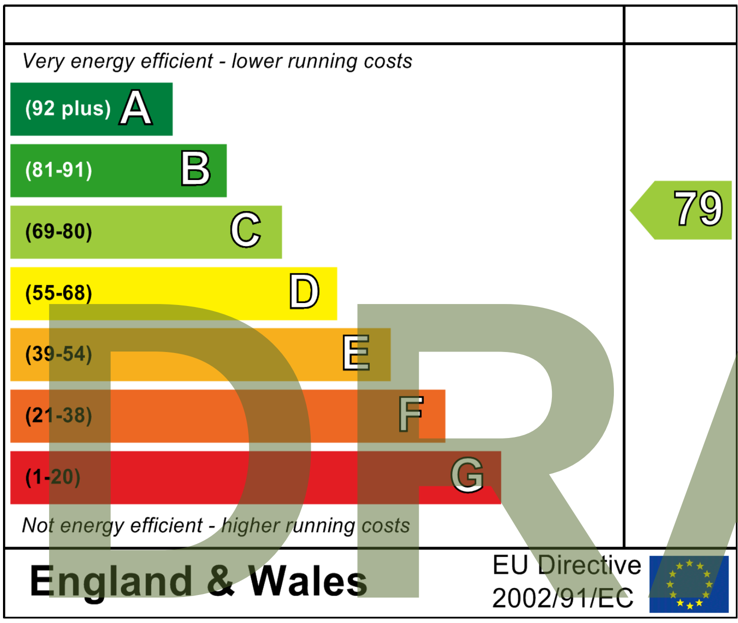
82 Guilford Street
London
WC1N 1DF

Dwelling type: Top floor Flat
Date of assessment: 15 July 2014
Produced by: Stroma Certification
Total floor area: 34.6 m²

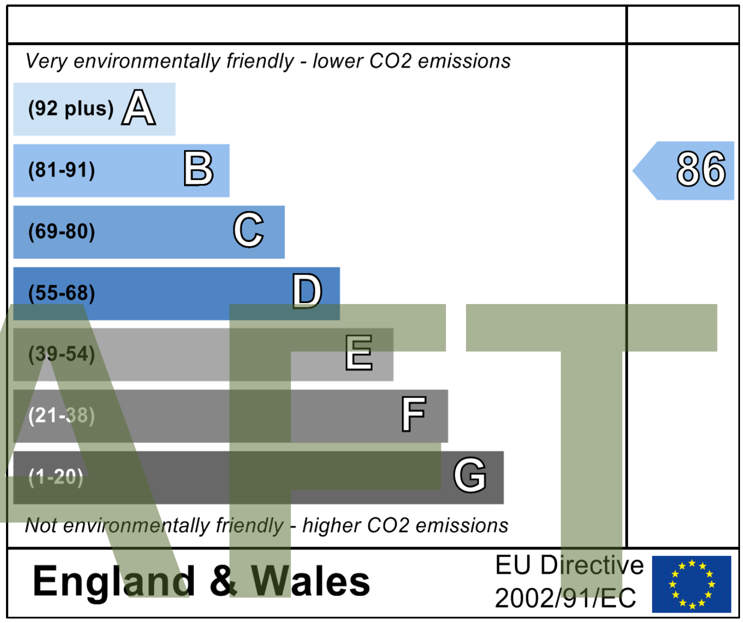
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2009 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



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The environmental impact rating is a measure of a home’s impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.