Highgate Newtown Community Centre and
Fresh Youth Academy

Energy Strategy

NOVEMBER 2018

Community Investment Programme

Camden

Document

Energy Strategy Report

Project

Highgate Newtown Residential and Community Centre Redevelopment

Client

London Borough of Camden

Date

November 2018

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REVISION HISTORY

Suitability	Revision	Version Date	Summary of Changes	Changes marked
D5	P1	30-10-2018	Draft for comment	
D5	P2	09-11-2018	With updated calculations	

DISTRIBUTION

This document has been distributed to:

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Lewis Westhoff	Iceni

APPROVALS

This document requires the following approvals:

Name	Title
Rolfe Jackson	Director

CONTENTS

1.0 EXECUTIVE SUMMARY

This Energy Strategy has been prepared by McBains Ltd for the revised scheme at Highgate Newtown Community Centre in support of the Section 73 Application. The scheme comprises 39 new private dwellings, 2 houses within the refurbished Gospel Hall, and a new community centre. This document supersedes the previous Energy Strategy (VZdV, Rev 3, 28th Oct 2016).

It has been prepared as part of a series of documents to support the application, in conjunction with which it should be read, and addresses requirements related to energy use and carbon dioxide emissions reduction in accordance with local and national policy. The main policy and guidance context of the responses includes:

- London Borough of Camden – Local Plan (July 2017)
- The London Plan - Minor Alterations to the London Plan (MALP) (March 2016)

This document sets out how the expected energy demands of the proposed dwellings have been analysed, and formed the site-wide energy strategy in accordance with the Mayor's energy hierarchy, maximising the contribution at each step. A summary of key outcomes is provided below.

The reduction of regulated carbon dioxide emissions of the proposed scheme have been estimated as 37% across the residential and commercial elements from a Part L 2013 compliant baseline by maximising the contribution at each step of the energy hierarchy. Having minimised energy demand, a Combined Heat and Power unit will be specified and, finally, a PV array of 30 - 35kWp is proposed.

<u>LEAN:</u>

Energy demand has been minimised through a highly efficient building envelope and systems in terms of U-values and air-tightness, inverter driven pumps, reduced thermal bridges, the inclusion of high efficiency lighting throughout coupled with PIR sensors, occupancy detectors and dimmers. High efficiency heat recovery in the mechanical ventilation system will also be specified. The challenging Target Fabric Energy Efficiency criterion introduced in Part L1A 2013 is complied with across the residential elements of the development.

The overall contribution of lean measures across the site is a 6% reduction in carbon dioxide emissions.

<u>CLEAN:</u>

Further reductions have been achieved through the use of a Combined Heat and Power (CHP) unit. To ensure efficient operation throughout the year, the CHP unit will be sized to meet approximately 60%

of the space heating and domestic hot water load of the site wide load. The remaining heating load will be met by high efficiency gas boilers, with individual combi boilers for the 2 no. houses.

The overall contribution of clean measures across the site is a further 16% reduction in carbon dioxide emissions.

GREEN:

To further reduce the carbon dioxide emissions of the proposed development, an assessment of potential low and zero carbon technologies has been undertaken. The preferred option would be to install a PV array (40 - 45kWp) to contribute towards the electrical load of the development.

The overall contribution of green measures across the site is a further 15% reduction in carbon dioxide emissions.

It is expected that the proposed development will achieve a reduction of an estimated 40% in regulated CO_2 reductions compared to Building Regulations Part L 2013.

The expected CO_2 savings are as follows for each stage of the energy hierarchy:

Table 1: Site wide CO_2 Emissions after each stage of the Energy Hierarchy

Carbon dioxide emissions from proposed measures (tonnes CO_2/annum)	Regulated	Unregulated
Baseline: Part L 2013 compliance	72.8	38.3
After energy demand reduction	68.1	38.3
After heat network / CHP	56.2	38.3
After renewable energy	**45.5**	**38.3**

Table 2: Site wide Regulated CO_2 savings from each stage of the Energy Hierarchy

Regulated carbon dioxide emissions savings from proposed measures	($tnCO_2$/annum)	(%)
Savings from energy demand reduction	4.7	6 %
Savings from heat network / CHP	12.0	16 %
Savings from renewable energy	10.6	14 %
Cumulative on site savings	27.3	37 %

Table 3: Cumulative Regulated carbon dioxide savings from residential and commercial areas

Regulated carbon dioxide emissions savings from proposed measures	($tnCO_2$/annum)	(%)
Residential cumulative CO_2 savings	19.9	40 %
Commercial cumulative CO_2 savings	7.4	31 %
Site wide cumulative CO_2 savings	27.3	37 %

Table 4: Cumulative savings for off-set payment for Carbon Zero Homes (residential only)

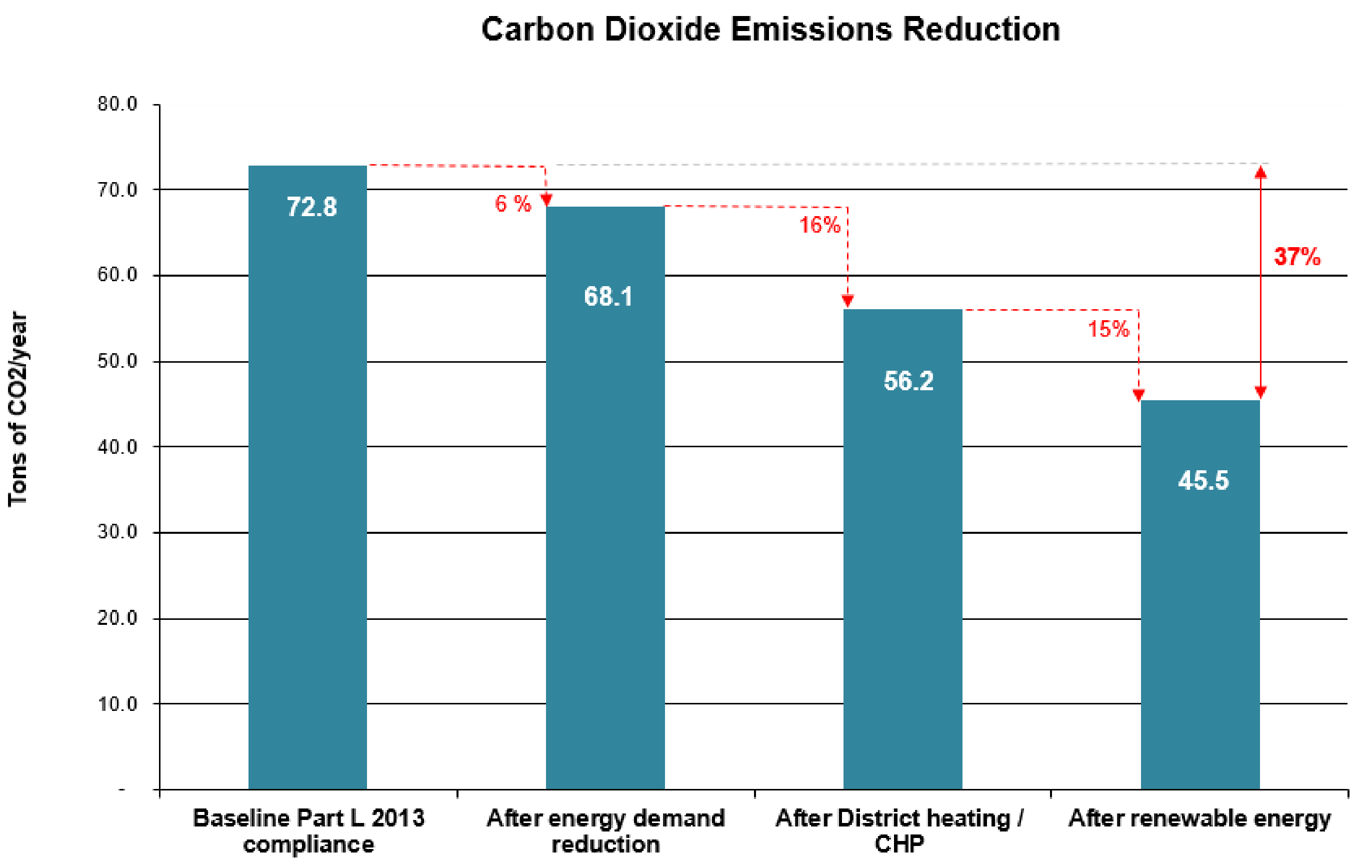
	($tnCO_2$/annum)
Annual Savings from off-set payment	**29.1**
Cumulative savings for off-set payment (over 30 years)	**871**

Table 5: Cumulative savings for off-set payment for Commercial areas (to reach 35% CO_2 saving)

	($tnCO_2$/annum)
Annual Savings from off-set payment	**0.9**
Cumulative savings for off-set payment (over 30 years)	**28**

The expected CO_2 carbon off-set payment for Carbon Zero Homes and Commercial areas will be £53,991.

The development is expected to achieve regulated CO_2 reductions of an estimated 37% compared with Part L1A 2013 as shown below.



2.0 METHODOLOGY

2.1 The Accredited Software

In order to determine the baseline consumption and improvements in the private residential dwellings, a series of Standard Assessment Procedure (SAP) assessments were carried out. A representative sample of 11 dwellings (25% of the development) was selected to show a range of compliance strategies and potential improvements. For this exercise the Stroma FSAP 2012 Calculator Version 1.0.4.16 was used, which is also a government accredited software package (checked by BRE on behalf of DECC, CLG, SBS and DFPNI).

In order to develop the Simplified Building Energy Model (SBEM) for the non-domestic elements of the development, EDSL's TAS software was used (version 1.0.4.16). This is an accredited piece of software in accordance with CIBSE TM33:2006.

2.2 The Approach

Once the Part L 2013 calculations were set up according to the information from the rest of the design team, the energy hierarchy was applied as described in London Plan Policy 5.2 Minimising carbon dioxide emissions;

- Be lean: Use less energy
- Be clean: Supply energy efficiently
- Be green: Use renewable energy

- <u>The Baseline:</u> The Building/Dwelling Emission Rate (BER/DER) of the development and the Target Emission Rates (TER) of the corresponding notional buildings were calculated using SBEM and SAP in accordance with Building Regulations Part L 2013. For the residential element of the development, SAP calculations were undertaken in order to establish an overall figure for the Dwelling Emission Rate (DER) across the residential element of the development. Similarly, full SBEM simulations were carried out for the community centre to estimate the associated energy demand and regulated carbon dioxide emissions.

- The Energy Hierarchy: Once the baselines were determined, the energy hierarchy was applied to maximise the reduction of carbon dioxide emissions; energy efficiency measures first, followed by an assessment of the options for meeting the remaining energy demand efficiently and finally an assessment of the options to further reduce carbon dioxide emissions from renewable energy generated onsite.

Following preliminary calculations it is expected that overall regulated carbon dioxide emissions will be reduced by at least 37% across the development compared to Part L 2013 through the Lean, Clean and Green measures.

3.0 THE BASELINE

To assess the performance of the residential element of the development, the following parameters summarised in Table 3 were applied to the representative sample dwellings.

Table 3: RESIDENTIAL - Fabric and services parameters

Element or system	Units	Highgate Newtown	Notional building (Part L1a 2013)	Limiting Values (Part 1a 2013)
FABRIC PERFORMANCE				
Ground Floor - U value	W/m^2K	0.11	0.13	0.25
External Walls - U value	W/m^2K	0.15	0.18	0.3
Party walls - U value	W/m^2K	0	0	0.2
Roof - U value	W/m^2K	0.11	0.13	0.25
Windows, rooflights, glazed doors				
U value	W/m^2K	1.4	1.4	2
g value		0.44 - 0.558 - Flats 0.76 - House	0.63	-
frame factor		0.7		
External Doors		1.4	1	
Air tightness	$m^3/hr/m^2$	3	5	10
Thermal bridging (y factor)		Accredited Construction Details		
BUILDING SERVICES				
CHP heat efficiency (fraction of load)	%	51% (0.60)		
CHP electrical efficiency	%	33		
Boiler efficiency (fraction of thermal	%	91% (0.40)	89.5%	
Energy efficient lighting	%	100	100	100
Mechanical ventilation & heat recovery: Specific Fan Power (SFP) / heat recovery efficiency	W / L / s	SFP = 0.53 / 94%		
Mechanical cooling SEER		None		

Table 4: COMMERCIAL - Fabric and services parameters

Element or system	Units	Highgate Newtown	Notional building (Part L1a 2013)	Limiting Values (Part 1a 2013)
FABRIC PERFORMANCE				
External Walls - U value	W/m^2K	0.24	0.18	0.3
Party walls - U value	W/m^2K	0	0	0.2
Roof - U value	W/m^2K	0.15	0.13	0.25
Windows, rooflights, glazed doors				
U value	W/m^2K	1.59	1.4	2
g value		0.512	0.63	-
frame factor		0.8		
External Doors		1.63	1	
Air tightness	$m^3/hr/m^2$	3	5	10
BUILDING SERVICES				
CHP heat efficiency (fraction of load)	%	51% (0.60)		
CHP electrical efficiency	%	33		
Boiler efficiency (fraction of thermal	%	91% (0.40)	89.5%	
Lighting (lm/W)	%	80	100	100
Mechanical ventilation & heat recovery: Specific Fan Power (SFP) / heat recovery efficiency	W / L / s	SFP = 1.6 / 70%		
Mechanical cooling SEER		None		

4.0 IMPROVEMENTS FROM REDUCING ENERGY DEMAND ('BE LEAN')

Reducing carbon emissions from the total energy needs (heating, cooling and power) of the development is one of the fundamental aims of any development adopting the principles of sustainable design in order to mitigate the effects of climate change and help conserve fossil fuel resources.

The first step in the energy hierarchy is to use passive design and energy efficiency measures to reduce the energy demand of the building. From preliminary calculations, it is estimated that a regulated carbon dioxide emissions reduction of 6% over Part L 2013 across the development as a whole through lean measures alone can be achieved. It is worth noting that the challenging Target Fabric Energy Efficiency criterion has been achieved in all of the sample dwellings and on a block basis this criterion is passed.

A. Building Fabric Improvements and Overheating

The glazed areas in the residential element of the scheme are a key component. The proportion of glazing to façade area was assessed with careful consideration of beneficial heat gain, winter heat losses, daylight and aesthetic appeal of the building. Windows with a U-value of 1.40 W/m^2K are proposed. This will help to minimise excessive heat loss in winter and solar gain in the summer, reducing the associated heating load in winter and the risk of overheating in summer. Furthermore, external wall U-values of 0.15 – 0.22 W/m^2K have been selected.

B. Air Tightness Improvements

An improvement upon the minimum requirements of the Part L 2013 will be targeted with $3m^3/m^2$hour at 50 Pa pressure. The Contractor will incorporate suitable construction details into the design and adopt best practice construction practices in order to achieve these figures.

C. Thermal Bridging

Thermal bridging will be carefully considered to improve upon the minimum default y value of 0.15. Thermal bridges at all window junctions (sills, jambs and lintels) will be designed with Accredited Construction Details to ensure that heat transferred through to the building is reduced. Particular attention will also be paid to the balconies, which are one of the highest risk areas to cause thermal bridging due to construction method and detailing.

D. Luminaires and Controls

Low energy lighting has become an essential feature of building design. Advances in lamp and ballast design have led to higher efficiency luminaires with control measures having become standard in most new developments in order to respond to changes to standards such as Part L of the Building Regulations and sustainability assessment methods such as BREEAM and the Code for Sustainable Homes.

Lighting controls can consist of simple presence detection which when combined with daylight control can switch luminaires on/off automatically or regulate the lighting levels in accordance with the outside conditions. These systems are proposed for use in conjunction with each other for the most energy efficient installation. Daylight control is intended for use to control external lighting.

Energy efficient light fittings will be provided throughout the development to reduce the electrical load. Daylight sensors and timers will be installed to all external lighting (not including security lighting). High efficiency lamps will be installed in communal areas managed by the landlord. These will be controlled by a combination of infrared occupancy control.

E. Ventilation

Due to the high performance of the building fabric and the location of the development, relying solely on natural ventilation for the residential dwellings is not considered an appropriate strategy and a balanced mechanical ventilation strategy with mechanical extract is proposed. This will ensure minimum fresh air requirements, moisture and odour removal from the kitchen and toilet areas and allow for a boost / purge facility to increase the volume of air flow controlled. In order to optimise the energy performance of the system, each unit will incorporate heat recovery.

For the community centre, a natural ventilation strategy is proposed. Given that the building is on multiple floors and based around a central atrium with large open spaces, the opportunity exists to adopt this operational strategy.

F. Comfort Cooling

The controlled ventilation strategies and high performance fabric within both the residential dwellings and community centre assume that comfort cooling will not be required. Likewise, both buildings will be provided with openable windows, and a summertime boost function on the MVHR (mechanical ventilation unit) will allow the occupants choice as to how to regulate the internal comfort within the apartment blocks.

It should be noted that internal blinds are assumed for all dwellings, with certain units requiring white coloured blinds subject to the exact U values and glazing g-values confirmed at Detailed Design.

The table below demonstrates how the development has addressed the issue of cooling in line with Cooling Hierarchy as included within Policy 5.2 of the Minor Alterations to the London Plan (MALP) (March 2016).

Cooling hierarchy	Proposed Development
1 minimise internal heat generation through energy efficient design	Selection of high performance glazing units with U values and g- values that exceed Part L 2013 requirements.
2 reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls	In terms of external shading, window reveals and a significant quantum of balconies substantially reduce excessive solar gains. Areas of green roofs are also being considered in combination with the roof mounted PV arrays.
3 manage the heat within the building through exposed internal thermal mass and high ceilings	An ample floor –ceiling height of 2.5m is provided. A nighttime cooling strategy via openable windows or rooflights is proposed to allow the structure of the buildings to cool down.
4 passive ventilation	Openable windows are provided to all dwellings and the community centre allow users control over their environment
5 mechanical ventilation	Mechanical ventilation with heat recovery is to be installed in all dwellings, with a summertime boost function.
6 active cooling systems (ensuring they are the lowest carbon options).	More indepth overheating analysis will be undertaken at a later stage in order to inform the solar control glazing specification. No active cooling systems are not proposed at this stage.

5.0 IMPROVEMENT FROM SUPPLYING ENERGY EFFICIENTLY ('BE CLEAN')

5.1 District Heating Network

The London Plan shows great support for district heating networks and all developments are required to assess the feasibility of connecting to existing or planned networks, and also the integration with nearby proposed development.

Although not indicated on the London Heat Map below, existing heating networks exist in close proximity and are under London Borough of Camden's ownership. These are Highgate Newtown and Brookfield. However, it is our understanding that these networks are both refurbishments and the respective plant rooms do not include sufficient capacity to extend the networks to service the Highgate Newtown Community Centre.

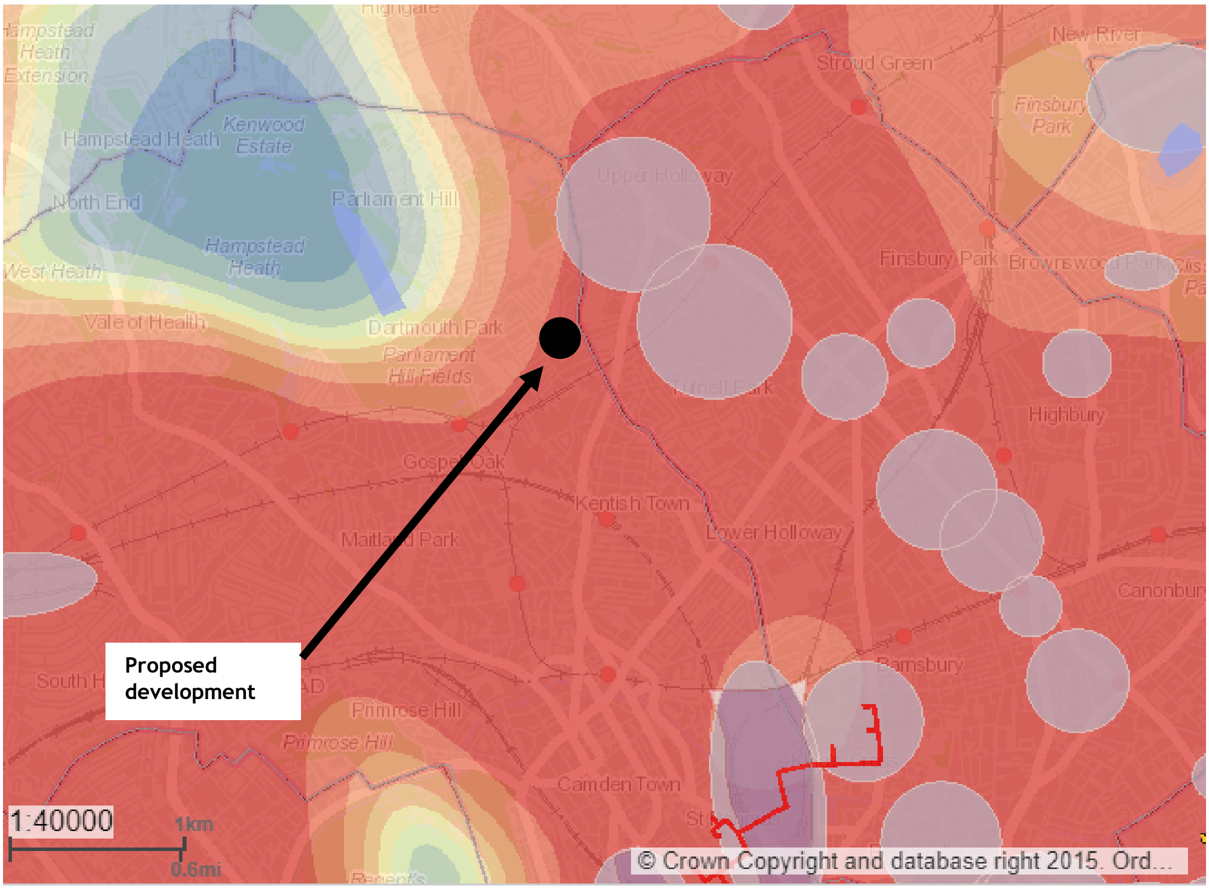


Figure 1: London Heat Map showing heat loads and district heating networks in the vicinity of the proposed development.

- Heat mapping decentralised energy potential
- Potential District Heating Networks
- Rivers, lakes or sea
- Existing District Heating Networks

5.2 Combined Heat and Power (CHP)

Connecting to a district heating network was the first option assessed. As no suitable heat network currently exists, nor plans confirmed in terms of future network routes, the next priority in Policy 5.6 of the London Plan (MALP) 2016 to be assessed is to install a Combined Heat and Power (CHP) unit. As the technology would be installed onsite, the transmission losses associated with larger district networks would be far reduced. Furthermore, for every unit of electricity generated, the heat can be captured and used for 'free' to contribute to a thermal base load. These two main advantages lead to significant carbon dioxide emissions reductions.

The residential led nature of the scheme is particularly suited to CHP given the large, consistent thermal loads, which allow the CHP unit to run constantly for long periods. This allows it to run most efficiently and maximises its working life. It is assumed that the CHP will be sized to meet around 60% of the total heat demand in the development and it will have community boilers as back up. Detailed calculations load profile calculations will be carried out at Detailed Design

The inclusion of the community centre within the site wide energy network also complements CHP. The electricity generated whilst the CHP runs during the daytime will directly correspondence with electrical load of the community centre.

In order to estimate the size for the CHP unit, the main considerations are twofold:

1. To ensure the unit would run at the rated output for at least 10 hours per day and 329 days a year (to account for maintenance 10% downtime); and
2. Avoid the need to export electricity or heat

At this concept stage, it is proposed that a CHP unit of approximately 20 – 25 kWe capacity is installed with thermal stores in order to maximise running hours. This will be examined further at Detailed Design, ensuring that the unit selected will have NOx emissions less than 40mg/kWh.

A potential CHP unit for installation is as follows:

XRGI 20 (SAV Systems)

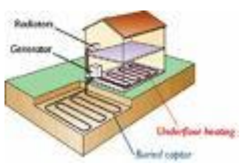
- Electrical rated output (kWe) [efficiency] : 20
- Thermal rated output (kWth) [efficiency]: 38.7
- Overall efficiency 96%

6.0 IMPROVEMENT FROM INTRODUCING RENEWABLE ENERGY TECHNOLOGIES ('BE GREEN')

6.1 Initial feasibility

A renewable and low carbon technology feasibility study has been carried out to investigate the contribution that on-site generation from renewable energy technologies could make to further reduce the carbon dioxide emissions in the proposed development. The following technologies have been assessed in terms of their technical feasibility and potential CO_2 emissions savings:

- Solar thermal water heating;
- Photovoltaics;
- Biomass heating;
- Building mounted and stand-alone wind turbines;
- Ground source heat pumps (GSHP); and
- Air source heat pumps (ASHP).

Technology	Feasibility	Comments
Ground or Air Source Heat Pumps  	✗	Heat Pumps typically meet a proportion of the heating and cooling loads and can be incorporated into the piles of a building structure. However, given that the CHP will provide a significant portion of the thermal demand, it is considered that ground and air source heat pumps being installed in addition would be duplication.

Technology	Feasibility	Comments
Photovoltaics 	✔	The proposed development has a large area of flat or south facing roof and thus with the appropriate mounting systems can be very favourable for the installation of Photovoltaic panels. Photovoltaic cells would contribute to a proportion of the electrical load of the scheme and also benefit from the Feed in Tariff.
Solar Hot Water Systems 	✘	The hot water load is substantial in any residential scheme. In this case this has been addressed at the second step of the energy hierarchy through the Combined Heat and Power plant; therefore the solar thermal technology would not make a further contribution to the carbon dioxide emissions reduction and will not be considered further.
Biomass Heating 	✘	A communal biomass boiler would be unsuitable for the development due to its central London location and the associated implications of fuel deliveries. Furthermore, given the restricted space between buildings and regular pedestrian movements related to the Community Centre, fuel deliveries from large vehicles would be deemed to pose a significant safety risk. This will not be further considered.

Technology	Feasibility	Comments
Wind (roof mounted) 	✕	Roof mounted wind turbines are not recommended for this site due to noise, flicker and vibration implications on the residential/non-domestic areas. Numerous inner city wind turbine trials have shown that such turbines' energy yields are significantly lower than manufacturers' estimations. This will not be further considered.
Wind (standalone) 	✕	Small-scale (10m mast), standalone turbines are not suitable for this development due to lack of space on the site and relatively low wind speeds that would be achieved in this very urban environment. This will not be further considered.

6.2 Preferred Options for Renewables

As the proposed development will not include structural piles, a ground source heat pump system is not proposed. The significant roof area is suitable for solar technology, and due to the presence of the CHP unit within the energy strategy, it is considered that a PV array is most suitable.

It is proposed that a 120 - 130 panel PV array is installed which will equate to 30 - 35 kWp, with active area of approximately 190m^2. Please refer to Appendix A for an indicative PV layout.

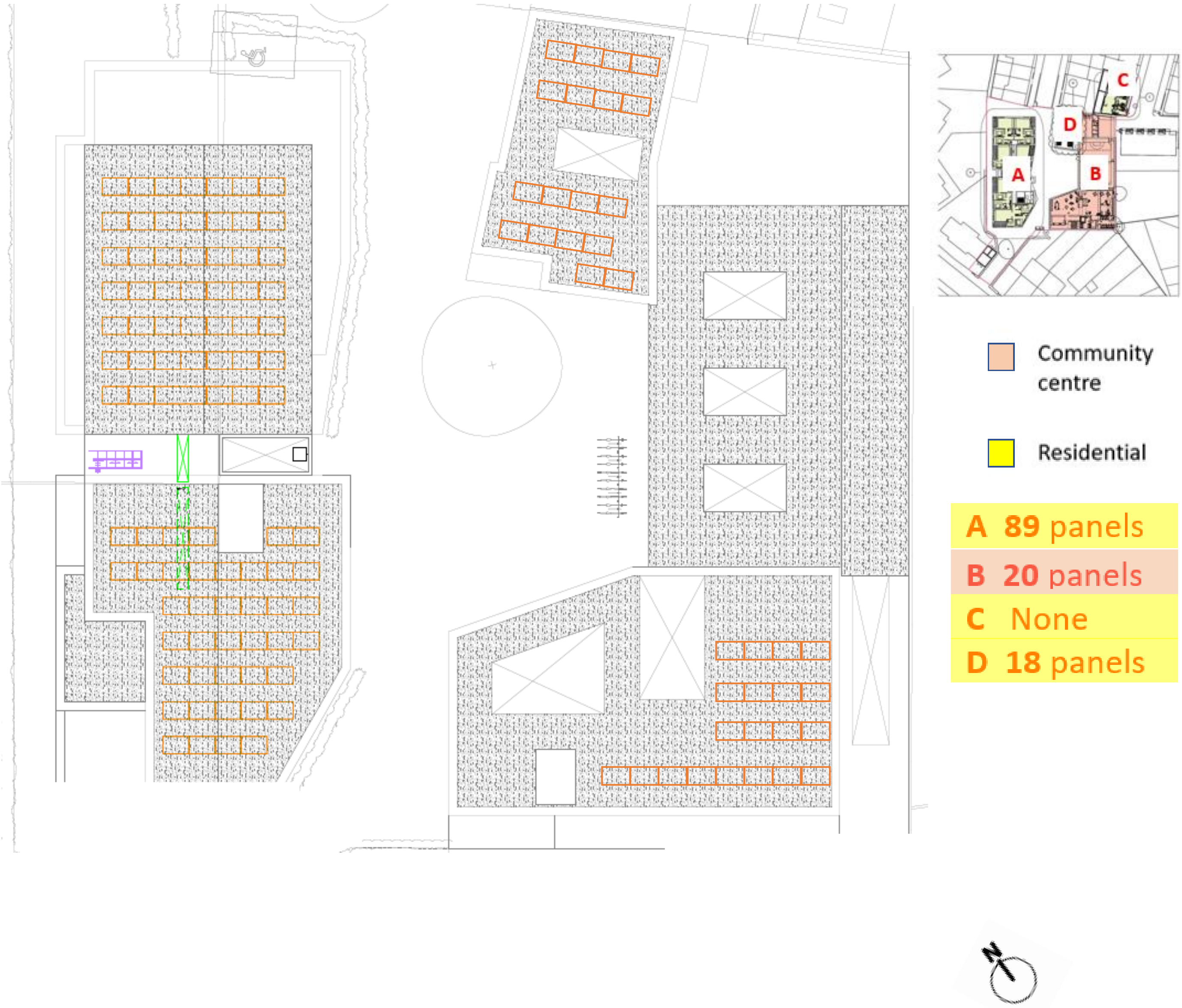
Indicative details of the PV panels are listed below:

Solar PV Information Required		Units
Model	Sanyo HIT-H250E01	
Efficiency	18	%
Number of PV panels	127	
Area of PV panels	190	m^2
Total Capacity (Installed Power)	7	kWp
Total Energy Output	26,130	kWh/year
CO_2 Offset	13,560	kgCO_2
Emissions Reductions	15	%
Additionally, FiT information can be provided	This array would qualify for a Feed In tariff of 4.11p/kWh as taken from the 'Higher' rate for 10 - 50kW if accreditation achieved before 31/12/18. It should be noted that on 19th July 2018 the Department of Business Energy and Industrial Strategy (BEIS) published a consultation in which they state their intention to close the FIT scheme to new applicants from 1 April 2019.	

APPENDIX A

PROPOSED PV LAYOUT

The proposed PV array is shown on the roof plans below. All panels will be tilted at 30 degrees in order to maximise the electricity generated.



APPENDIX B1

SAP OUTPUTS FOR SAMPLE UNITS

“LEAN”

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 1F-3

Address : 1F-3, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	70.75	(1a)	x	2.4	(2a)	=	169.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.75	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			169.8	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.8	x1/[1/(1.4)+ 0.04]		=	5.04			(27)
Windows Type 2			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Walls Type1	47.64	21.86	25.78	x	0.15	=	3.87	14	360.92	(29)
Walls Type2	8.02	0	8.02	x	0.14	=	1.13	14	112.28	(29)
Total area of elements, m²			55.66							(31)
Party wall			31.51	x	0	=	0	20	630.2	(32)
Party floor			70.75					40	2830	(32a)
Party ceiling			70.75					30	2122.5	(32b)
Internal wall **			105.6					9	950.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7006.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 99.03 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.36 (36)

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

Total fabric heat loss (33) + (36) = 39.5 (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=	14.74	14.56	14.38	13.49	13.31	12.42	12.42	12.24	12.78	13.31	13.67	14.03	(38)

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

(39)m=	54.24	54.06	53.88	52.99	52.81	51.92	51.92	51.74	52.27	52.81	53.17	53.52	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 52.94 (39)

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

(40)m=	0.77	0.76	0.76	0.75	0.75	0.73	0.73	0.73	0.74	0.75	0.75	0.76	

Average = $\text{Sum}(40)_{1\ldots12}$ /12= 0.75 (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 2.26 (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 87.97 (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=	96.77	93.25	89.73	86.22	82.7	79.18	79.18	82.7	86.22	89.73	93.25	96.77	

Total = $\text{Sum}(44)_{1\ldots12}$ = 1055.7 (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=	143.51	125.51	129.52	112.92	108.35	93.5	86.64	99.42	100.61	117.25	127.98	138.98	

Total = $\text{Sum}(45)_{1\ldots12}$ = 1384.18 (45)

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

(46)m=	21.53	18.83	19.43	16.94	16.25	14.02	13	14.91	15.09	17.59	19.2	20.85	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	198.79	175.44	184.8	166.41	163.63	146.99	141.91	154.7	154.1	172.52	181.48	194.26	(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=	198.79	175.44	184.8	166.41	163.63	146.99	141.91	154.7	154.1	172.52	181.48	194.26

Output from water heater (annual)$_{1...12}$ | 2035.02 | (64)

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

(65)m=	91.94	81.68	87.29	80.34	80.25	73.88	73.03	77.28	76.25	83.21	85.35	90.43	(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=	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	(66)

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

(67)m=	17.74	15.76	12.82	9.7	7.25	6.12	6.62	8.6	11.54	14.66	17.11	18.24	(67)

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

(68)m=	199.04	201.11	195.9	184.82	170.83	157.69	148.91	146.84	152.05	163.13	177.11	190.26	(68)

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

(69)m=	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	(71)

Water heating gains (Table 5)

(72)m=	123.57	121.54	117.32	111.58	107.86	102.61	98.16	103.87	105.9	111.84	118.54	121.55	(72)

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

(73)m=	397.32	395.37	383	363.07	342.91	323.39	310.64	316.27	326.45	346.58	369.73	387.01	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.8	x	10.63	x	0.558	x	0.7	=	10.94	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.558	x	0.7	=	20.9	(74)

North	0.9x	0.77	x	3.8	x	34.53	x	0.558	x	0.7	=	35.52	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.558	x	0.7	=	57.05	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.558	x	0.7	=	76.85	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.558	x	0.7	=	82.27	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.558	x	0.7	=	76.81	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.558	x	0.7	=	60.94	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.558	x	0.7	=	42.7	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.558	x	0.7	=	24.88	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.558	x	0.7	=	13.49	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.558	x	0.7	=	9.12	(74)
West	0.9x	0.77	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(80)
West	0.9x	0.77	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(80)
West	0.9x	0.77	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(80)
West	0.9x	0.77	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(80)
West	0.9x	0.77	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(80)
West	0.9x	0.77	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(80)
West	0.9x	0.77	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(80)
West	0.9x	0.77	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(80)
West	0.9x	0.77	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(80)
West	0.9x	0.77	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(80)
West	0.9x	0.77	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(80)
West	0.9x	0.77	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(80)

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

(83)m=	95.79	186.88	308.87	455.71	565.43	582.42	552.97	469.95	360.62	221.83	119.29	78.89	(83)

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

(84)m=	493.11	582.26	691.87	818.79	908.34	905.81	863.61	786.23	687.07	568.42	489.01	465.9	(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=	0.94	0.9	0.82	0.67	0.51	0.36	0.26	0.3	0.5	0.76	0.9	0.95	(86)

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

(87)m=	19.7	19.98	20.37	20.73	20.91	20.98	21	20.99	20.94	20.66	20.12	19.65	(87)

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

(88)m=	20.28	20.28	20.29	20.3	20.3	20.31	20.31	20.31	20.31	20.3	20.3	20.29	(88)

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

(89)m=	0.93	0.89	0.8	0.65	0.48	0.32	0.22	0.26	0.45	0.73	0.89	0.94	(89)

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

(90)m=	18.53	18.93	19.47	19.97	20.21	20.29	20.31	20.31	20.25	19.89	19.15	18.47	(90)

fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	18.94	19.3	19.79	20.24	20.46	20.54	20.55	20.55	20.5	20.16	19.49	18.89	(92)

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

(93)m=	18.94	19.3	19.79	20.24	20.46	20.54	20.55	20.55	20.5	20.16	19.49	18.89	(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=	0.91	0.87	0.79	0.64	0.48	0.34	0.24	0.27	0.47	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	450.78	506.49	543.95	527.39	439.31	303.51	204.1	213.06	319.76	413.59	427.41	430.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	794.29	778.57	715.99	601.05	462.46	308.22	205.12	214.71	334.31	504.86	658.81	786.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	255.57	182.84	128	53.03	17.22	0	0	0	0	67.91	166.61	264.3	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1135.49 (98)

Space heating requirement in kWh/m²/year 16.05 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1135.49	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1192.26	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2035.02	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2136.77	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.29	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f):				
mechanical ventilation - balanced, extract or positive input from outside			137.24	(330a)
warm air heating system fans			0	(330b)
pump for solar water heating			0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =		137.24	(331)
Energy for lighting (calculated in Appendix L)			313.38	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	803.43	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	17.28	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	820.71	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				820.71	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	71.23	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	162.64	(379)
Total CO2, kg/year	sum of (376)…(382) =				1054.58	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.91	(384)
EI rating (section 14)					87.79	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 1F-4

Address : 1F-4, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	58.06	(1a)	x	2.4	(2a)	=	139.34	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	58.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			139.34	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Windows Type 2			2.4	x1/[1/(1.4)+ 0.04]		=	3.18			(27)
Floor			58.06	x	0.2	=	11.612	75	4354.5	(28)
Walls Type1	30.84	20.46	10.38	x	0.15	=	1.56	14	145.32	(29)
Walls Type2	24.12	0	24.12	x	0.14	=	3.4	14	337.68	(29)
Walls Type3	9.6	0	9.6	x	0.15	=	1.44	14	134.4	(29)
Total area of elements, m²			122.62							(31)
Party wall			16.32	x	0	=	0	20	326.4	(32)
Party ceiling			58.06					30	1741.8	(32b)
Internal wall **			81.6					9	734.4	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.29 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7774.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 133.9 (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 13.72 (36)

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

Total fabric heat loss (33) + (36) = 59.01 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	11.44	11.3	11.17	10.5	10.37	9.7	9.7	9.57	9.97	10.37	10.64	10.9	(38)

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

(39)m=	70.45	70.31	70.18	69.51	69.38	68.71	68.71	68.58	68.98	69.38	69.64	69.91	

Average = Sum(39)$_{1…12}$ /12= 69.48 (39)

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

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2	

Average = Sum(40)$_{1…12}$ /12= 1.2 (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 1.93 (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 79.95 (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=	87.94	84.75	81.55	78.35	75.15	71.95	71.95	75.15	78.35	81.55	84.75	87.94	

Total = Sum(44)$_{1…12}$ = 959.39 (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=	130.42	114.07	117.7	102.62	98.46	84.97	78.73	90.35	91.43	106.55	116.31	126.3	

Total = Sum(45)$_{1…12}$ = 1257.91 (45)

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

(46)m=	19.56	17.11	17.66	15.39	14.77	12.75	11.81	13.55	13.71	15.98	17.45	18.95	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	185.7	163.99	172.98	156.11	153.74	138.46	134.01	145.63	144.92	161.83	169.8	181.58	(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=	185.7	163.99	172.98	156.11	153.74	138.46	134.01	145.63	144.92	161.83	169.8	181.58

Output from water heater (annual)$_{1...12}$ — 1908.75 (64)

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

(65)m=	87.59	77.87	83.36	76.92	76.96	71.05	70.4	74.26	73.19	79.65	81.47	86.22	(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=	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	(66)

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

(67)m=	14.98	13.31	10.82	8.19	6.12	5.17	5.59	7.26	9.75	12.37	14.44	15.4	(67)

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

(68)m=	168.03	169.77	165.38	156.02	144.22	133.12	125.71	123.96	128.36	137.71	149.52	160.62	(68)

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

(69)m=	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	(71)

Water heating gains (Table 5)

(72)m=	117.72	115.88	112.04	106.83	103.44	98.68	94.62	99.82	101.66	107.06	113.15	115.88	(72)

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

(73)m=	352.63	350.85	340.13	322.94	305.68	288.86	277.81	282.93	291.66	309.03	329	343.79	(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)

North	0.9x	0.77	x	2.4	x	10.63	x	0.558	x	0.7	=	6.91	(74)
North	0.9x	0.77	x	2.4	x	20.32	x	0.558	x	0.7	=	13.2	(74)
North	0.9x	0.77	x	2.4	x	34.53	x	0.558	x	0.7	=	22.43	(74)
North	0.9x	0.77	x	2.4	x	55.46	x	0.558	x	0.7	=	36.03	(74)
North	0.9x	0.77	x	2.4	x	74.72	x	0.558	x	0.7	=	48.54	(74)
North	0.9x	0.77	x	2.4	x	79.99	x	0.558	x	0.7	=	51.96	(74)
North	0.9x	0.77	x	2.4	x	74.68	x	0.558	x	0.7	=	48.51	(74)
North	0.9x	0.77	x	2.4	x	59.25	x	0.558	x	0.7	=	38.49	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.558	x	0.7	=	26.97	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.558	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.558	x	0.7	=	8.52	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.558	x	0.7	=	5.76	(74)
East	0.9x	1	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(76)
East	0.9x	1	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(76)
East	0.9x	1	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(76)
East	0.9x	1	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(76)
East	0.9x	1	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(76)
East	0.9x	1	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(76)
East	0.9x	1	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(76)
East	0.9x	1	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(76)
East	0.9x	1	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(76)
East	0.9x	1	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(76)
East	0.9x	1	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(76)
East	0.9x	1	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(76)

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

(83)m=	91.76	179.18	295.78	434.7	537.12	552.11	524.67	447.5	344.89	212.67	114.32	75.53	(83)

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

(84)m=	444.38	530.03	635.92	757.63	842.79	840.97	802.48	730.43	636.54	521.7	443.32	419.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.94	0.9	0.79	0.65	0.49	0.37	0.41	0.64	0.86	0.95	0.97	(86)

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

(87)m=	19.13	19.41	19.87	20.39	20.75	20.92	20.98	20.97	20.82	20.31	19.62	19.07	(87)

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

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.92	(88)

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

(89)m=	0.96	0.93	0.88	0.76	0.59	0.42	0.28	0.32	0.57	0.83	0.94	0.97	(89)

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

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(90)m=	17.44	17.85	18.5	19.22	19.67	19.87	19.92	19.92	19.77	19.13	18.16	17.36	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	18.26	18.61	19.17	19.79	20.19	20.39	20.44	20.43	20.29	19.71	18.87	18.2	(92)

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

(93)m=	18.26	18.61	19.17	19.79	20.19	20.39	20.44	20.43	20.29	19.71	18.87	18.2	(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=	0.95	0.92	0.86	0.75	0.61	0.45	0.32	0.37	0.59	0.82	0.92	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.77	487.76	548.26	571.29	512.42	375.91	257.88	267.63	375.83	428.59	409.68	400.79	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	983.55	964.32	889.21	756.99	589.29	397.53	263.58	276.22	426.63	631.9	819.89	978.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	417.96	320.25	253.67	133.7	57.19	0	0	0	0	151.26	295.35	429.78	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2059.16 (98)

Space heating requirement in kWh/m²/year 35.47 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 2059.16

Space heat from Community boilers (98) x (304a) x (305) x (306) = 2162.12 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement 1908.75

If DHW from community scheme:
Water heat from Community boilers (64) x (303a) x (305) x (306) = 2004.19 (310a)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = 41.66 (313)

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Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		112.62	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	112.62	(331)
Energy for lighting (calculated in Appendix L)		264.55	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1005.5	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	21.62	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1027.12	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1027.12	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	58.45	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	137.3	(379)
Total CO2, kg/year	sum of (376)…(382) =				1222.88	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				21.06	(384)
EI rating (section 14)					84.1	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 2F-5

Address : 2F-5, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.45	(1a) x	2.4	(2a) =	121.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.45	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	121.08	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

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

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)

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]

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			12.17	x1/[1/(1.4)+ 0.04]		=	16.13			(27)
Windows Type 2			1.68	x1/[1/(1.4)+ 0.04]		=	2.23			(27)
Walls Type1	30.27	15.95	14.32	x	0.15	=	2.15	14	200.48	(29)
Walls Type2	34.06	0	34.06	x	0.14	=	4.8	14	476.84	(29)
Total area of elements, m²			64.33							(31)
Party wall			10.8	x	0	=	0	20	216	(32)
Party floor			50.45					40	2018	(32a)
Party ceiling			50.45					30	1513.5	(32b)
Internal wall **			76.8					9	691.2	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.25 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5116.02 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 101.41 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.65 (36)

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

Total fabric heat loss (33) + (36) = 33.9 (37)

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

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

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(38)m=	9.94	9.82	9.71	9.13	9.01	8.43	8.43	8.31	8.66	9.01	9.24	9.47	(38)

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

(39)m=	43.84	43.72	43.61	43.03	42.91	42.33	42.33	42.22	42.56	42.91	43.14	43.38	

Average = $Sum(39)_{1...12}$ /12= 43 (39)

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

(40)m=	0.87	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = $Sum(40)_{1...12}$ /12= 0.85 (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 1.7 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.65 (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=	82.12	79.13	76.15	73.16	70.18	67.19	67.19	70.18	73.16	76.15	79.13	82.12	

Total = $Sum(44)_{1...12}$ = 895.86 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.78	106.51	109.91	95.82	91.94	79.34	73.52	84.37	85.37	99.49	108.61	117.94	

Total = $Sum(45)_{1...12}$ = 1174.61 (45)

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

(46)m=	18.27	15.98	16.49	14.37	13.79	11.9	11.03	12.65	12.81	14.92	16.29	17.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	177.06	156.44	165.19	149.32	147.22	132.83	128.8	139.64	138.87	154.77	162.1	173.22	(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=	177.06	156.44	165.19	149.32	147.22	132.83	128.8	139.64	138.87	154.77	162.1	173.22

Output from water heater (annual)$_{1...12}$ | 1825.45 | (64)

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

(65)m=	84.71	75.36	80.77	74.66	74.79	69.18	68.67	72.27	71.18	77.3	78.91	83.44	(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=	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	(66)

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

(67)m=	13.23	11.75	9.56	7.23	5.41	4.57	4.93	6.41	8.61	10.93	12.76	13.6	(67)

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

(68)m=	148.4	149.94	146.06	137.8	127.37	117.57	111.02	109.48	113.36	121.62	132.05	141.85	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	(71)

Water heating gains (Table 5)

(72)m=	113.86	112.14	108.56	103.69	100.53	96.08	92.29	97.14	98.86	103.9	109.59	112.15	(72)

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

(73)m=	324.05	322.38	312.73	297.27	281.86	266.76	256.8	261.59	269.38	285.01	302.95	316.15	(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)	
North	0.9x	0.77	x	1.68	x	10.63	x	0.558	x	0.7	=	4.84	(74)
North	0.9x	0.77	x	1.68	x	20.32	x	0.558	x	0.7	=	9.24	(74)

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North	0.9x	0.77	x	1.68	x	34.53	x	0.558	x	0.7	=	15.7	(74)
North	0.9x	0.77	x	1.68	x	55.46	x	0.558	x	0.7	=	25.22	(74)
North	0.9x	0.77	x	1.68	x	74.72	x	0.558	x	0.7	=	33.98	(74)
North	0.9x	0.77	x	1.68	x	79.99	x	0.558	x	0.7	=	36.37	(74)
North	0.9x	0.77	x	1.68	x	74.68	x	0.558	x	0.7	=	33.96	(74)
North	0.9x	0.77	x	1.68	x	59.25	x	0.558	x	0.7	=	26.94	(74)
North	0.9x	0.77	x	1.68	x	41.52	x	0.558	x	0.7	=	18.88	(74)
North	0.9x	0.77	x	1.68	x	24.19	x	0.558	x	0.7	=	11	(74)
North	0.9x	0.77	x	1.68	x	13.12	x	0.558	x	0.7	=	5.97	(74)
North	0.9x	0.77	x	1.68	x	8.86	x	0.558	x	0.7	=	4.03	(74)
East	0.9x	1	x	12.17	x	19.64	x	0.56	x	0.7	=	64.7	(76)
East	0.9x	1	x	12.17	x	38.42	x	0.56	x	0.7	=	126.57	(76)
East	0.9x	1	x	12.17	x	63.27	x	0.56	x	0.7	=	208.44	(76)
East	0.9x	1	x	12.17	x	92.28	x	0.56	x	0.7	=	303.99	(76)
East	0.9x	1	x	12.17	x	113.09	x	0.56	x	0.7	=	372.56	(76)
East	0.9x	1	x	12.17	x	115.77	x	0.56	x	0.7	=	381.38	(76)
East	0.9x	1	x	12.17	x	110.22	x	0.56	x	0.7	=	363.09	(76)
East	0.9x	1	x	12.17	x	94.68	x	0.56	x	0.7	=	311.89	(76)
East	0.9x	1	x	12.17	x	73.59	x	0.56	x	0.7	=	242.42	(76)
East	0.9x	1	x	12.17	x	45.59	x	0.56	x	0.7	=	150.18	(76)
East	0.9x	1	x	12.17	x	24.49	x	0.56	x	0.7	=	80.67	(76)
East	0.9x	1	x	12.17	x	16.15	x	0.56	x	0.7	=	53.21	(76)

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

(83)m=	69.54	135.81	224.14	329.22	406.53	417.75	397.05	338.83	261.3	161.18	86.64	57.24	(83)

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

(84)m=	393.58	458.19	536.87	626.49	688.39	684.51	653.85	600.42	530.69	446.19	389.59	373.39	(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	0.89	0.82	0.69	0.53	0.38	0.28	0.32	0.51	0.76	0.89	0.94	(86)

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

(87)m=	19.58	19.85	20.25	20.65	20.87	20.97	20.99	20.99	20.92	20.58	20.02	19.52	(87)

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

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

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

(89)m=	0.92	0.88	0.8	0.66	0.5	0.34	0.23	0.27	0.46	0.73	0.88	0.93	(89)

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

(90)m=	18.29	18.68	19.24	19.78	20.07	20.19	20.21	20.21	20.14	19.72	18.93	18.22	(90)

fLA = Living area ÷ (4) = | 0.53 | (91)

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

(92)m=	18.97	19.3	19.77	20.24	20.49	20.6	20.62	20.62	20.55	20.17	19.5	18.91	(92)

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

(93)m=	18.97	19.3	19.77	20.24	20.49	20.6	20.62	20.62	20.55	20.17	19.5	18.91	(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	0.86	0.79	0.66	0.51	0.36	0.26	0.29	0.49	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	356.41	396.05	423.06	413.33	350.38	247.38	168.63	175.66	257.54	325.69	337.39	341.9	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	642.99	629.51	578.65	487.85	377.3	253.92	170.25	178.1	274.35	410.78	535.12	637.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	213.21	156.89	115.76	53.65	20.03	0	0	0	0	63.31	142.37	220.21	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	985.44	(98)
Space heating requirement in kWh/m²/year	19.53	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		985.44	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1034.71	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1825.45	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1916.72	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.51	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside				97.86	(330a)
warm air heating system fans				0	(330b)
pump for solar water heating				0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =			97.86	(331)
Energy for lighting (calculated in Appendix L)				233.65	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	712.3	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	15.32	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	727.62	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				727.62	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	50.79	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	121.26	(379)
Total CO2, kg/year	sum of (376)…(382) =				899.67	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				17.83	(384)
EI rating (section 14)					87.37	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 2F-6

Address : 2F-6, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.35	(1a) x	2.4	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		176.04	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Walls Type1	33.84	18.06	15.78	x	0.15	=	2.37	14	220.92	(29)
Walls Type2	13.51	0	13.51	x	0.14	=	1.9	14	189.14	(29)
Walls Type3	13.82	0	13.82	x	0.15	=	2.07	14	193.48	(29)
Total area of elements, m²			61.17							(31)
Party wall			21.19	x	0	=	0	20	423.8	(32)
Party floor			73.35					40	2934	(32a)
Party ceiling			73.35					30	2200.5	(32b)
Internal wall **			105.6					9	950.4	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7112.24 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 96.96 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.02 (36)

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

Total fabric heat loss (33) + (36) = 36.46 (37)

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

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

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(38)m=	14.45	14.28	14.11	13.27	13.1	12.25	12.25	12.09	12.59	13.1	13.44	13.77	(38)

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

(39)m=	50.91	50.74	50.57	49.73	49.56	48.72	48.72	48.55	49.05	49.56	49.9	50.23	

Average = $Sum(39)_{1...12}$ /12= 49.69 (39)

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

(40)m=	0.69	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.67	0.68	0.68	0.68	

Average = $Sum(40)_{1...12}$ /12= 0.68 (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 2.32 (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 89.41 (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=	98.35	94.77	91.2	87.62	84.05	80.47	80.47	84.05	87.62	91.2	94.77	98.35	

Total = $Sum(44)_{1...12}$ = 1072.92 (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=	145.85	127.56	131.63	114.76	110.12	95.02	88.05	101.04	102.25	119.16	130.07	141.25	

Total = $Sum(45)_{1...12}$ = 1406.77 (45)

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

(46)m=	21.88	19.13	19.75	17.21	16.52	14.25	13.21	15.16	15.34	17.87	19.51	21.19	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	201.13	177.49	186.91	168.25	165.39	148.52	143.33	156.32	155.74	174.44	183.57	196.53	(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=	201.13	177.49	186.91	168.25	165.39	148.52	143.33	156.32	155.74	174.44	183.57	196.53	

Output from water heater (annual)$_{1...12}$	2057.61	(64)

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

(65)m=	92.72	82.36	87.99	80.95	80.84	74.39	73.5	77.82	76.79	83.84	86.04	91.19	(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=	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	(66)

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

(67)m=	18.29	16.24	13.21	10	7.48	6.31	6.82	8.86	11.9	15.11	17.63	18.8	(67)

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

(68)m=	204.99	207.11	201.75	190.34	175.94	162.4	153.35	151.23	156.59	168	182.4	195.94	(68)

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

(69)m=	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	(71)

Water heating gains (Table 5)

(72)m=	124.62	122.55	118.27	112.43	108.65	103.32	98.79	104.59	106.66	112.69	119.51	122.56	(72)

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

(73)m=	405.76	403.78	391.1	370.65	349.93	329.9	316.83	322.55	333.01	353.67	377.41	395.17	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(80)
West	0.9x	0.77	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(80)

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West	0.9x	0.77	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(80)
West	0.9x	0.77	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(80)
West	0.9x	0.77	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(80)
West	0.9x	0.77	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(80)
West	0.9x	0.77	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(80)
West	0.9x	0.77	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(80)
West	0.9x	0.77	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(80)
West	0.9x	0.77	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(80)
West	0.9x	0.77	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(80)
West	0.9x	0.77	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(80)

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

(83)m=	84.85	165.98	273.35	398.66	488.58	500.15	476.16	409.01	317.92	196.95	105.8	69.78	(83)

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

(84)m=	490.61	569.76	664.45	769.31	838.51	830.04	792.99	731.57	650.93	550.62	483.21	464.95	(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=	0.94	0.9	0.82	0.68	0.52	0.37	0.27	0.3	0.5	0.76	0.9	0.94	(86)

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

(87)m=	19.84	20.1	20.44	20.77	20.93	20.98	21	20.99	20.95	20.71	20.23	19.8	(87)

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

(88)m=	20.35	20.35	20.35	20.36	20.36	20.37	20.37	20.37	20.37	20.36	20.36	20.35	(88)

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

(89)m=	0.93	0.89	0.8	0.66	0.49	0.33	0.23	0.26	0.46	0.73	0.89	0.94	(89)

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

(90)m=	18.78	19.14	19.63	20.07	20.28	20.36	20.37	20.37	20.32	20.01	19.35	18.72	(90)

fLA = Living area ÷ (4) = | 0.39 | (91)

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

(92)m=	19.2	19.52	19.95	20.35	20.53	20.6	20.62	20.62	20.57	20.28	19.69	19.15	(92)

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

(93)m=	19.2	19.52	19.95	20.35	20.53	20.6	20.62	20.62	20.57	20.28	19.69	19.15	(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	0.87	0.79	0.65	0.5	0.35	0.25	0.28	0.47	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	448.62	496.91	526.11	503.74	417.4	288.49	194.83	203.36	305.48	401.09	422.3	429.92	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	758.56	741.69	680.03	569.2	437.81	292.5	195.66	204.66	317.42	479.97	628.4	750.83	(97)

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

(98)m=	230.59	164.49	114.52	47.13	15.19	0	0	0	0	58.69	148.39	238.76	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1017.76 (98)

Space heating requirement in kWh/m²/year 13.88 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1017.76	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1068.65	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2057.61	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2160.49	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	32.29	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		142.28	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	142.28	(331)
Energy for lighting (calculated in Appendix L)		322.98	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		89.5	(367a)

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CO_2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	779.32	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	16.76	(372)
Total CO_2 associated with community systems	(363)…(366) + (368)...(372)		=	796.08	(373)
CO_2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO_2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO_2 associated with space and water heating	(373) + (374) + (375) =			796.08	(376)
CO_2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	73.85	(378)
CO_2 associated with electricity for lighting	(332))) x	0.52	=	167.63	(379)
Total CO_2, kg/year	sum of (376)…(382) =			1037.55	(383)
Dwelling CO_2 Emission Rate	(383) ÷ (4) =			14.15	(384)
EI rating (section 14)				88.25	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 3F-7

Address : 3F-7, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	54.48	(1a)	x	2.4	(2a)	=	130.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.48	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	130.75	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows			12.15	x1/[1/(1.4)+ 0.04]		=	16.11			(27)
Walls Type1	31.32	14.25	17.07	x	0.15	=	2.56	14	238.98	(29)
Walls Type2	25.08	0	25.08	x	0.14	=	3.53	14	351.12	(29)
Walls Type3	12.6	0	12.6	x	0.13	=	1.67	14	176.4	(29)
Total area of elements, m²			69							(31)
Party wall			10.78	x	0	=	0	20	215.6	(32)
Party floor			54.48					40	2179.2	(32a)
Party ceiling			54.48					30	1634.4	(32b)
Internal wall **			57.6					9	518.4	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5314.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 97.54 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.74 (36)

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

Total fabric heat loss (33) + (36) = 32.54 (37)

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

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

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(38)m=	10.73	10.61	10.48	9.85	9.73	9.1	9.1	8.98	9.35	9.73	9.98	10.23	(38)

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

(39)m=	43.27	43.15	43.02	42.4	42.27	41.64	41.64	41.52	41.9	42.27	42.52	42.77	

Average = $Sum(39)_{1...12}$ /12= 42.37 (39)

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

(40)m=	0.79	0.79	0.79	0.78	0.78	0.76	0.76	0.76	0.77	0.78	0.78	0.79	

Average = $Sum(40)_{1...12}$ /12= 0.78 (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 1.82 (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 77.48 (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=	85.22	82.12	79.02	75.93	72.83	69.73	69.73	72.83	75.93	79.02	82.12	85.22	

Total = $Sum(44)_{1...12}$ = 929.7 (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=	126.38	110.54	114.06	99.44	95.42	82.34	76.3	87.55	88.6	103.25	112.71	122.39	

Total = $Sum(45)_{1...12}$ = 1218.98 (45)

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

(46)m=	18.96	16.58	17.11	14.92	14.31	12.35	11.44	13.13	13.29	15.49	16.91	18.36	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	181.66	160.46	169.34	152.94	150.69	135.83	131.57	142.83	142.09	158.53	166.2	177.67	(62)

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

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

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

Output from water heater

(64)m=	181.66	160.46	169.34	152.94	150.69	135.83	131.57	142.83	142.09	158.53	166.2	177.67

Output from water heater (annual)$_{1...12}$ | 1869.82 | (64)

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

(65)m=	86.24	76.69	82.15	75.86	75.95	70.17	69.59	73.33	72.25	78.55	80.27	84.92	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	(66)

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

(67)m=	14.16	12.58	10.23	7.74	5.79	4.89	5.28	6.86	9.21	11.7	13.65	14.55	(67)

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

(68)m=	158.84	160.49	156.34	147.5	136.33	125.84	118.83	117.19	121.34	130.18	141.34	151.84	(68)

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

(69)m=	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	(71)

Water heating gains (Table 5)

(72)m=	115.92	114.13	110.41	105.36	102.08	97.46	93.54	98.57	100.35	105.58	111.49	114.14	(72)

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

(73)m=	339.26	337.53	327.31	310.93	294.53	278.52	267.98	272.95	281.24	297.79	316.82	330.86	(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)	
West	0.9x	0.77	x	12.15	x	19.64	x	0.56	x	0.7	=	64.59	(80)
West	0.9x	0.77	x	12.15	x	38.42	x	0.56	x	0.7	=	126.36	(80)

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West	0.9x	0.77	x	12.15	x	63.27	x	0.56	x	0.7	=	208.09	(80)
West	0.9x	0.77	x	12.15	x	92.28	x	0.56	x	0.7	=	303.49	(80)
West	0.9x	0.77	x	12.15	x	113.09	x	0.56	x	0.7	=	371.94	(80)
West	0.9x	0.77	x	12.15	x	115.77	x	0.56	x	0.7	=	380.75	(80)
West	0.9x	0.77	x	12.15	x	110.22	x	0.56	x	0.7	=	362.49	(80)
West	0.9x	0.77	x	12.15	x	94.68	x	0.56	x	0.7	=	311.37	(80)
West	0.9x	0.77	x	12.15	x	73.59	x	0.56	x	0.7	=	242.02	(80)
West	0.9x	0.77	x	12.15	x	45.59	x	0.56	x	0.7	=	149.94	(80)
West	0.9x	0.77	x	12.15	x	24.49	x	0.56	x	0.7	=	80.54	(80)
West	0.9x	0.77	x	12.15	x	16.15	x	0.56	x	0.7	=	53.12	(80)

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

(83)m=	64.59	126.36	208.09	303.49	371.94	380.75	362.49	311.37	242.02	149.94	80.54	53.12	(83)

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

(84)m=	403.85	463.89	535.41	614.43	666.48	659.27	630.47	584.32	523.26	447.73	397.36	383.98	(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	0.89	0.82	0.7	0.54	0.39	0.29	0.32	0.52	0.76	0.89	0.94	(86)

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

(87)m=	19.68	19.93	20.3	20.67	20.88	20.97	20.99	20.99	20.93	20.62	20.1	19.63	(87)

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

(88)m=	20.26	20.26	20.26	20.27	20.27	20.28	20.28	20.29	20.28	20.27	20.27	20.27	(88)

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

(89)m=	0.92	0.88	0.8	0.67	0.51	0.35	0.24	0.27	0.47	0.73	0.88	0.93	(89)

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

(90)m=	18.48	18.84	19.36	19.87	20.14	20.26	20.28	20.28	20.21	19.82	19.09	18.42	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

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

(92)m=	19.02	19.34	19.78	20.23	20.48	20.58	20.6	20.6	20.53	20.18	19.54	18.97	(92)

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

(93)m=	19.02	19.34	19.78	20.23	20.48	20.58	20.6	20.6	20.53	20.18	19.54	18.97	(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	0.86	0.79	0.67	0.52	0.37	0.26	0.29	0.49	0.73	0.86	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	365.09	401.07	423.58	409.75	345.57	243.05	165.22	172.25	254.47	326.43	343.37	350.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	637.07	622.86	571.52	480.47	370.99	249	166.62	174.33	269.47	405.09	529.18	631.6	(97)

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

(98)m=	202.35	149.05	110.07	50.92	18.91	0	0	0	0	58.52	133.78	208.79

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 932.39 (98)

Space heating requirement in kWh/m²/year 17.11 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		932.39	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	979.01	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1869.82	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1963.32	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.42	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		105.68	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	105.68	(331)
Energy for lighting (calculated in Appendix L)		250.09	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		89.5	(367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	710.1	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	15.27	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	725.37	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			725.37	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	54.85	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	129.8	(379)
Total CO2, kg/year	sum of (376)…(382) =			910.02	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			16.7	(384)
EI rating (section 14)				87.74	(385)

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User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 3F-8

Address : 3F-8, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.7	(1a)	x	2.4	(2a)	=	160.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.7	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			160.08	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.9	(23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Windows Type 3			7.63	x1/[1/(1.4)+ 0.04]		=	10.12			(27)
Walls Type1	52.8	21.9	30.9	x	0.15	=	4.64	14	432.6	(29)
Walls Type2	10.39	0	10.39	x	0.14	=	1.46	14	145.46	(29)
Total area of elements, m²			63.19							(31)
Party wall			20.53	x	0	=	0	20	410.6	(32)
Party floor			66.7					40	2668	(32a)
Party ceiling			66.7					30	2001	(32b)
Internal wall **			96					9	864	(32c)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	35.29	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6521.66	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	97.78	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		5.88	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	41.17	(37)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.9	13.73	13.56	12.72	12.55	11.71	11.71	11.54	12.04	12.55	12.89	13.22	(38)

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

(39)m=	55.06	54.89	54.73	53.88	53.71	52.87	52.87	52.7	53.21	53.71	54.05	54.39	

Average = Sum(39)$_{1…12}$ /12= 53.84 (39)

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

(40)m=	0.83	0.82	0.82	0.81	0.81	0.79	0.79	0.79	0.8	0.81	0.81	0.82	

Average = Sum(40)$_{1…12}$ /12= 0.81 (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 2.16 (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 85.58 (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=	94.14	90.72	87.29	83.87	80.45	77.02	77.02	80.45	83.87	87.29	90.72	94.14	

Total = Sum(44)$_{1…12}$ = 1026.98 (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=	139.61	122.1	126	109.85	105.4	90.95	84.28	96.71	97.87	114.06	124.5	135.2	

Total = Sum(45)$_{1…12}$ = 1346.53 (45)

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

(46)m=	20.94	18.32	18.9	16.48	15.81	13.64	12.64	14.51	14.68	17.11	18.68	20.28	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	194.88	172.03	181.27	163.34	160.68	144.45	139.56	151.99	151.36	169.33	178	190.48	(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=	194.88	172.03	181.27	163.34	160.68	144.45	139.56	151.99	151.36	169.33	178	190.48

Output from water heater (annual)$_{1...12}$ | 1997.37 | (64)

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

(65)m=	90.64	80.54	86.12	79.32	79.27	73.04	72.24	76.38	75.34	82.15	84.19	89.18	(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=	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	(66)

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

(67)m=	16.89	15	12.2	9.24	6.9	5.83	6.3	8.19	10.99	13.95	16.29	17.36	(67)

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

(68)m=	189.48	191.44	186.49	175.94	162.62	150.11	141.75	139.78	144.74	155.29	168.6	181.12	(68)

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

(69)m=	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	(71)

Water heating gains (Table 5)

(72)m=	121.83	119.85	115.75	110.17	106.54	101.44	97.1	102.66	104.63	110.41	116.93	119.86	(72)

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

(73)m=	383.65	381.75	369.89	350.79	331.52	312.83	300.6	306.08	315.81	335.1	357.27	373.79	(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	7.63	x	36.79	x	0.56	x	0.7	=	75.99	(77)
Southeast	0.9x	0.77	x	7.63	x	62.67	x	0.56	x	0.7	=	129.44	(77)
Southeast	0.9x	0.77	x	7.63	x	85.75	x	0.56	x	0.7	=	177.11	(77)
Southeast	0.9x	0.77	x	7.63	x	106.25	x	0.56	x	0.7	=	219.44	(77)
Southeast	0.9x	0.77	x	7.63	x	119.01	x	0.56	x	0.7	=	245.8	(77)
Southeast	0.9x	0.77	x	7.63	x	118.15	x	0.56	x	0.7	=	244.02	(77)
Southeast	0.9x	0.77	x	7.63	x	113.91	x	0.56	x	0.7	=	235.26	(77)
Southeast	0.9x	0.77	x	7.63	x	104.39	x	0.56	x	0.7	=	215.6	(77)
Southeast	0.9x	0.77	x	7.63	x	92.85	x	0.56	x	0.7	=	191.77	(77)
Southeast	0.9x	0.77	x	7.63	x	69.27	x	0.56	x	0.7	=	143.06	(77)
Southeast	0.9x	0.77	x	7.63	x	44.07	x	0.56	x	0.7	=	91.02	(77)
Southeast	0.9x	0.77	x	7.63	x	31.49	x	0.56	x	0.7	=	65.03	(77)
South	0.9x	0.77	x	3.82	x	46.75	x	0.56	x	0.7	=	48.34	(78)
South	0.9x	0.77	x	3.82	x	76.57	x	0.56	x	0.7	=	79.17	(78)
South	0.9x	0.77	x	3.82	x	97.53	x	0.56	x	0.7	=	100.85	(78)
South	0.9x	0.77	x	3.82	x	110.23	x	0.56	x	0.7	=	113.98	(78)
South	0.9x	0.77	x	3.82	x	114.87	x	0.56	x	0.7	=	118.78	(78)
South	0.9x	0.77	x	3.82	x	110.55	x	0.56	x	0.7	=	114.31	(78)
South	0.9x	0.77	x	3.82	x	108.01	x	0.56	x	0.7	=	111.69	(78)
South	0.9x	0.77	x	3.82	x	104.89	x	0.56	x	0.7	=	108.46	(78)
South	0.9x	0.77	x	3.82	x	101.89	x	0.56	x	0.7	=	105.35	(78)
South	0.9x	0.77	x	3.82	x	82.59	x	0.56	x	0.7	=	85.4	(78)
South	0.9x	0.77	x	3.82	x	55.42	x	0.56	x	0.7	=	57.3	(78)
South	0.9x	0.77	x	3.82	x	40.4	x	0.56	x	0.7	=	41.77	(78)
West	0.9x	0.77	x	8.35	x	19.64	x	0.56	x	0.7	=	44.39	(80)
West	0.9x	0.77	x	8.35	x	38.42	x	0.56	x	0.7	=	86.84	(80)
West	0.9x	0.77	x	8.35	x	63.27	x	0.56	x	0.7	=	143.01	(80)
West	0.9x	0.77	x	8.35	x	92.28	x	0.56	x	0.7	=	208.57	(80)
West	0.9x	0.77	x	8.35	x	113.09	x	0.56	x	0.7	=	255.62	(80)
West	0.9x	0.77	x	8.35	x	115.77	x	0.56	x	0.7	=	261.67	(80)
West	0.9x	0.77	x	8.35	x	110.22	x	0.56	x	0.7	=	249.12	(80)
West	0.9x	0.77	x	8.35	x	94.68	x	0.56	x	0.7	=	213.99	(80)
West	0.9x	0.77	x	8.35	x	73.59	x	0.56	x	0.7	=	166.33	(80)
West	0.9x	0.77	x	8.35	x	45.59	x	0.56	x	0.7	=	103.04	(80)
West	0.9x	0.77	x	8.35	x	24.49	x	0.56	x	0.7	=	55.35	(80)
West	0.9x	0.77	x	8.35	x	16.15	x	0.56	x	0.7	=	36.51	(80)

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

(83)m=	168.73	295.45	420.97	542	620.19	620	596.07	538.05	463.45	331.5	203.67	143.31	(83)

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

(84)m=	552.37	677.2	790.86	892.8	951.71	932.83	896.67	844.14	779.26	666.6	560.95	517.1	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

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

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(86)m=	0.91	0.85	0.76	0.63	0.49	0.35	0.26	0.28	0.45	0.69	0.86	0.92	(86)

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

(87)m=	19.72	20.06	20.42	20.73	20.9	20.98	20.99	20.99	20.95	20.7	20.17	19.66	(87)

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

(88)m=	20.23	20.23	20.24	20.25	20.25	20.26	20.26	20.26	20.26	20.25	20.24	20.24	(88)

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

(89)m=	0.9	0.84	0.74	0.61	0.46	0.32	0.21	0.24	0.41	0.66	0.85	0.92	(89)

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

(90)m=	18.53	19	19.5	19.93	20.14	20.24	20.26	20.26	20.2	19.9	19.18	18.44	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

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

(92)m=	19.07	19.48	19.91	20.29	20.49	20.57	20.59	20.59	20.54	20.26	19.63	18.99	(92)

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

(93)m=	19.07	19.48	19.91	20.29	20.49	20.57	20.59	20.59	20.54	20.26	19.63	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.82	0.73	0.61	0.47	0.33	0.23	0.26	0.42	0.66	0.83	0.9	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	488.18	556.14	579.83	542.31	446.34	309.75	209.56	218.79	329.19	441.15	465.65	464.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	813.3	800.32	734.08	613.88	472.03	315.76	210.96	220.77	342.68	519.01	677.18	804.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	241.89	164.09	114.76	51.53	19.12	0	0	0	0	57.92	152.3	253.04	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1054.66 | (98)

Space heating requirement in kWh/m²/year | 15.81 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	1054.66

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1107.39	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1997.37	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2097.24	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	32.05	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		129.38	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	129.38	(331)
Energy for lighting (calculated in Appendix L)		298.32	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	773.41	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	16.63	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	790.04	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				790.04	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	67.15	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	154.83	(379)
Total CO2, kg/year	sum of (376)…(382) =				1012.02	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				15.17	(384)
EI rating (section 14)					87.86	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 4F-10

Address : 4F-10, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	86.56	(1a) x	2.4	(2a) =	207.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.56	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	207.74	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.22	x1/[1/(1.4)+ 0.04]		=	20.18			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Walls Type1	52.25	25.67	26.58	x	0.15	=	3.99	14	372.12	(29)
Walls Type2	17.09	0	17.09	x	0.14	=	2.41	14	239.26	(29)
Roof	86.56	0	86.56	x	0.11	=	9.52	9	779.04	(30)
Total area of elements, m²			155.9							(31)
Party wall			32.95	x	0	=	0	20	659	(32)
Party floor			86.56					40	3462.4	(32a)
Internal wall **			163.2					9	1468.8	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 50.1 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6980.62 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 80.64 (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 12.37 (36)

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

Total fabric heat loss (33) + (36) = 62.47 (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

DER WorkSheet: New dwelling design stage

(38)m=	18.03	17.82	17.6	16.5	16.29	15.19	15.19	14.98	15.63	16.29	16.72	17.16	(38)

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

(39)m=	80.51	80.29	80.07	78.98	78.76	77.67	77.67	77.45	78.11	78.76	79.2	79.64	

Average = $Sum(39)_{1...12}$ /12= 78.92 (39)

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

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.91	0.92	

Average = $Sum(40)_{1...12}$ /12= 0.91 (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 2.58 (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 95.37 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	104.91	101.09	97.28	93.46	89.65	85.83	85.83	89.65	93.46	97.28	101.09	104.91	

Total = $Sum(44)_{1...12}$ = 1144.46 (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=	155.58	136.07	140.41	122.41	117.46	101.36	93.92	107.78	109.06	127.1	138.74	150.67	

Total = $Sum(45)_{1...12}$ = 1500.57 (45)

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

(46)m=	23.34	20.41	21.06	18.36	17.62	15.2	14.09	16.17	16.36	19.07	20.81	22.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94	(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=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94

Output from water heater (annual)$_{1...12}$ | 2151.41 | (64)

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

(65)m=	95.95	85.18	90.91	83.5	83.28	76.5	75.45	80.06	79.06	86.48	88.93	94.32	(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=	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	(66)

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

(67)m=	20.74	18.42	14.98	11.34	8.48	7.16	7.73	10.05	13.49	17.13	19.99	21.31	(67)

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

(68)m=	232.6	235.02	228.94	215.99	199.64	184.28	174.02	171.6	177.68	190.63	206.98	222.34	(68)

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

(69)m=	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	(71)

Water heating gains (Table 5)

(72)m=	128.97	126.76	122.19	115.97	111.93	106.24	101.41	107.6	109.8	116.24	123.51	126.77	(72)

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

(73)m=	443.94	441.83	427.74	404.93	381.68	359.32	344.8	350.89	362.61	385.64	412.12	432.06	(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)	
North	0.9x	0.77	x	8.35	x	10.63	x	0.558	x	0.7	=	24.03	(74)
North	0.9x	0.77	x	8.35	x	20.32	x	0.558	x	0.7	=	45.93	(74)

North	0.9x	0.77	x	8.35	x	34.53	x	0.558	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	8.35	x	55.46	x	0.558	x	0.7	=	125.36	(74)
North	0.9x	0.77	x	8.35	x	74.72	x	0.558	x	0.7	=	168.87	(74)
North	0.9x	0.77	x	8.35	x	79.99	x	0.558	x	0.7	=	180.79	(74)
North	0.9x	0.77	x	8.35	x	74.68	x	0.558	x	0.7	=	168.79	(74)
North	0.9x	0.77	x	8.35	x	59.25	x	0.558	x	0.7	=	133.91	(74)
North	0.9x	0.77	x	8.35	x	41.52	x	0.558	x	0.7	=	93.84	(74)
North	0.9x	0.77	x	8.35	x	24.19	x	0.558	x	0.7	=	54.67	(74)
North	0.9x	0.77	x	8.35	x	13.12	x	0.558	x	0.7	=	29.65	(74)
North	0.9x	0.77	x	8.35	x	8.86	x	0.558	x	0.7	=	20.04	(74)
East	0.9x	1	x	15.22	x	19.64	x	0.56	x	0.7	=	80.91	(76)
East	0.9x	1	x	15.22	x	38.42	x	0.56	x	0.7	=	158.29	(76)
East	0.9x	1	x	15.22	x	63.27	x	0.56	x	0.7	=	260.68	(76)
East	0.9x	1	x	15.22	x	92.28	x	0.56	x	0.7	=	380.18	(76)
East	0.9x	1	x	15.22	x	113.09	x	0.56	x	0.7	=	465.92	(76)
East	0.9x	1	x	15.22	x	115.77	x	0.56	x	0.7	=	476.96	(76)
East	0.9x	1	x	15.22	x	110.22	x	0.56	x	0.7	=	454.08	(76)
East	0.9x	1	x	15.22	x	94.68	x	0.56	x	0.7	=	390.05	(76)
East	0.9x	1	x	15.22	x	73.59	x	0.56	x	0.7	=	303.18	(76)
East	0.9x	1	x	15.22	x	45.59	x	0.56	x	0.7	=	187.82	(76)
East	0.9x	1	x	15.22	x	24.49	x	0.56	x	0.7	=	100.89	(76)
East	0.9x	1	x	15.22	x	16.15	x	0.56	x	0.7	=	66.54	(76)

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

(83)m=	104.95	204.22	338.72	505.54	634.8	657.74	622.87	523.96	397.01	242.49	130.54	86.58	(83)

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

(84)m=	548.89	646.05	766.46	910.47	1016.48	1017.06	967.66	874.85	759.63	628.13	542.66	518.64	(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=	0.94	0.91	0.85	0.74	0.6	0.45	0.34	0.38	0.59	0.81	0.91	0.95	(86)

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

(87)m=	18.88	19.2	19.7	20.28	20.68	20.89	20.96	20.95	20.77	20.21	19.44	18.83	(87)

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

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)

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

(89)m=	0.93	0.9	0.84	0.72	0.56	0.4	0.28	0.32	0.54	0.79	0.9	0.94	(89)

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

(90)m=	17.29	17.74	18.45	19.26	19.8	20.07	20.14	20.13	19.93	19.18	18.11	17.21	(90)

fLA = Living area ÷ (4) = 0.28 (91)

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

(92)m=	17.73	18.14	18.8	19.55	20.04	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(92)

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

(93)m=	17.73	18.14	18.8	19.55	20.04	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(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	0.87	0.81	0.7	0.56	0.41	0.29	0.34	0.54	0.76	0.88	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	498.31	563.31	618.37	633.32	564.9	414	284.33	294.23	411.81	479.05	475.16	475.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1081.22	1063.43	984.82	840.83	657.14	442.6	292.9	306.62	473.72	698.45	901.19	1071.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	433.69	336.08	272.64	149.41	68.63	0	0	0	0	163.24	306.74	443.57	

Total per year (kWh/year) = Sum(98)1...5,9...12 =	2173.98	(98)
Space heating requirement in kWh/m²/year	25.12	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2173.98	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2282.68	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2151.41	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2258.98	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	45.42	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f):					
mechanical ventilation - balanced, extract or positive input from outside				167.91	(330a)
warm air heating system fans				0	(330b)
pump for solar water heating				0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =			167.91	(331)
Energy for lighting (calculated in Appendix L)				366.22	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1096.09	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	23.57	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1119.66	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1119.66	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	87.14	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	190.07	(379)
Total CO2, kg/year	sum of (376)…(382) =				1396.87	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.14	(384)
EI rating (section 14)					85.77	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 4F-9

Address : 4F-9, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	86.56	(1a) x	2.4	(2a) =	207.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.56	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		207.74	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.22	x1/[1/(1.4)+ 0.04]		=	20.18			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Walls Type1	51.14	25.67	25.47	x	0.15	=	3.82	14	356.58	(29)
Walls Type2	8.21	0	8.21	x	0.14	=	1.16	14	114.94	(29)
Walls Type3	9.98	0	9.98	x	0.13	=	1.32	14	139.72	(29)
Roof	86.56	0	86.56	x	0.11	=	9.52	9	779.04	(30)
Total area of elements, m²			155.89							(31)
Party wall			32.95	x	0	=	0	20	659	(32)
Party floor			86.56					40	3462.4	(32a)
Internal wall **			163.2					9	1468.8	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 50.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6980.48 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 80.64 (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 12.37 (36)

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

Total fabric heat loss (33) + (36) = 62.38 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.03	17.82	17.6	16.5	16.29	15.19	15.19	14.98	15.63	16.29	16.72	17.16	(38)

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

(39)m=	80.41	80.19	79.97	78.88	78.66	77.57	77.57	77.35	78.01	78.66	79.1	79.54	

Average = Sum(39)$_{1…12}$ /12= 78.83 (39)

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

(40)m=	0.93	0.93	0.92	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.91	0.92	

Average = Sum(40)$_{1…12}$ /12= 0.91 (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 2.58 (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 95.37 (43)

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

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

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

(44)m=	104.91	101.09	97.28	93.46	89.65	85.83	85.83	89.65	93.46	97.28	101.09	104.91

Total = Sum(44)$_{1…12}$ = 1144.46 (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=	155.58	136.07	140.41	122.41	117.46	101.36	93.92	107.78	109.06	127.1	138.74	150.67

Total = Sum(45)$_{1…12}$ = 1500.57 (45)

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

(46)m=	23.34	20.41	21.06	18.36	17.62	15.2	14.09	16.17	16.36	19.07	20.81	22.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94	(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=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94

Output from water heater (annual)$_{1...12}$ — 2151.41 (64)

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

(65)m=	95.95	85.18	90.91	83.5	83.28	76.5	75.45	80.06	79.06	86.48	88.93	94.32	(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=	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	(66)

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

(67)m=	20.74	18.42	14.98	11.34	8.48	7.16	7.73	10.05	13.49	17.13	19.99	21.31	(67)

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

(68)m=	232.6	235.02	228.94	215.99	199.64	184.28	174.02	171.6	177.68	190.63	206.98	222.34	(68)

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

(69)m=	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	(71)

Water heating gains (Table 5)

(72)m=	128.97	126.76	122.19	115.97	111.93	106.24	101.41	107.6	109.8	116.24	123.51	126.77	(72)

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

(73)m=	443.94	441.83	427.74	404.93	381.68	359.32	344.8	350.89	362.61	385.64	412.12	432.06	(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)

North	0.9x	0.77	x	8.35	x	10.63	x	0.558	x	0.7	=	24.03	(74)
North	0.9x	0.77	x	8.35	x	20.32	x	0.558	x	0.7	=	45.93	(74)
North	0.9x	0.77	x	8.35	x	34.53	x	0.558	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	8.35	x	55.46	x	0.558	x	0.7	=	125.36	(74)
North	0.9x	0.77	x	8.35	x	74.72	x	0.558	x	0.7	=	168.87	(74)
North	0.9x	0.77	x	8.35	x	79.99	x	0.558	x	0.7	=	180.79	(74)
North	0.9x	0.77	x	8.35	x	74.68	x	0.558	x	0.7	=	168.79	(74)
North	0.9x	0.77	x	8.35	x	59.25	x	0.558	x	0.7	=	133.91	(74)
North	0.9x	0.77	x	8.35	x	41.52	x	0.558	x	0.7	=	93.84	(74)
North	0.9x	0.77	x	8.35	x	24.19	x	0.558	x	0.7	=	54.67	(74)
North	0.9x	0.77	x	8.35	x	13.12	x	0.558	x	0.7	=	29.65	(74)
North	0.9x	0.77	x	8.35	x	8.86	x	0.558	x	0.7	=	20.04	(74)
West	0.9x	0.77	x	15.22	x	19.64	x	0.56	x	0.7	=	80.91	(80)
West	0.9x	0.77	x	15.22	x	38.42	x	0.56	x	0.7	=	158.29	(80)
West	0.9x	0.77	x	15.22	x	63.27	x	0.56	x	0.7	=	260.68	(80)
West	0.9x	0.77	x	15.22	x	92.28	x	0.56	x	0.7	=	380.18	(80)
West	0.9x	0.77	x	15.22	x	113.09	x	0.56	x	0.7	=	465.92	(80)
West	0.9x	0.77	x	15.22	x	115.77	x	0.56	x	0.7	=	476.96	(80)
West	0.9x	0.77	x	15.22	x	110.22	x	0.56	x	0.7	=	454.08	(80)
West	0.9x	0.77	x	15.22	x	94.68	x	0.56	x	0.7	=	390.05	(80)
West	0.9x	0.77	x	15.22	x	73.59	x	0.56	x	0.7	=	303.18	(80)
West	0.9x	0.77	x	15.22	x	45.59	x	0.56	x	0.7	=	187.82	(80)
West	0.9x	0.77	x	15.22	x	24.49	x	0.56	x	0.7	=	100.89	(80)
West	0.9x	0.77	x	15.22	x	16.15	x	0.56	x	0.7	=	66.54	(80)

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

(83)m=	104.95	204.22	338.72	505.54	634.8	657.74	622.87	523.96	397.01	242.49	130.54	86.58	(83)

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

(84)m=	548.89	646.05	766.46	910.47	1016.48	1017.06	967.66	874.85	759.63	628.13	542.66	518.64	(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=	0.94	0.91	0.85	0.74	0.6	0.45	0.34	0.38	0.59	0.81	0.91	0.95	(86)

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

(87)m=	18.89	19.2	19.7	20.28	20.68	20.9	20.96	20.95	20.77	20.21	19.45	18.83	(87)

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

(88)m=	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.16	20.15	(88)

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

(89)m=	0.93	0.9	0.84	0.72	0.56	0.4	0.28	0.32	0.54	0.79	0.9	0.94	(89)

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

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(90)m=	17.29	17.74	18.46	19.27	19.8	20.07	20.14	20.13	19.93	19.19	18.11	17.21	(90)

fLA = Living area ÷ (4) = 0.28 (91)

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

(92)m=	17.73	18.15	18.8	19.55	20.05	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(92)

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

(93)m=	17.73	18.15	18.8	19.55	20.05	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(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	0.87	0.81	0.7	0.56	0.41	0.29	0.34	0.54	0.76	0.88	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	498.3	563.28	618.28	633.13	564.59	413.68	284.08	293.98	411.58	478.95	475.13	475.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1080.25	1062.47	983.92	840.02	656.47	442.13	292.59	306.3	473.24	697.8	900.37	1070.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	432.98	335.46	272.03	148.97	68.36	0	0	0	0	162.83	306.17	442.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2169.64 (98)

Space heating requirement in kWh/m²/year 25.07 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2169.64	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2278.13	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2151.41	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2258.98	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	45.37	(313)

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Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		167.91	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	167.91	(331)
Energy for lighting (calculated in Appendix L)		366.22	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1094.99	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	23.55	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1118.54	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1118.54	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	87.14	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	190.07	(379)
Total CO2, kg/year	sum of (376)…(382) =				1395.75	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.12	(384)
EI rating (section 14)					85.78	(385)

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User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 GF-1

Address : GF-1, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	73.52	(1a)	x	2.4	(2a)	=	176.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.52	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			176.45	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.8	x1/[1/(1.4)+ 0.04]		=	5.04			(27)
Windows Type 2			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Floor			73.52	x	0.11	=	8.087199	110	8087.2	(28)
Walls Type1	47.64	21.86	25.78	x	0.15	=	3.87	14	360.92	(29)
Walls Type2	2.4	0	2.4	x	0.14	=	0.34	14	33.6	(29)
Total area of elements, m²			123.56							(31)
Party wall			37.13	x	0	=	0	20	742.6	(32)
Party ceiling			73.52					30	2205.6	(32b)
Internal wall **			110.4					9	993.6	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.43 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12423.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 168.98 (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 9.46 (36)

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

Total fabric heat loss (33) + (36) = 50.89 (37)

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

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

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(38)m=	14.48	14.31	14.14	13.3	13.13	12.28	12.28	12.11	12.62	13.13	13.47	13.81	(38)

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

(39)m=	65.37	65.2	65.03	64.19	64.02	63.17	63.17	63	63.51	64.02	64.36	64.7	

Average = Sum(39)$_{1...12}$ /12= 64.15 (39)

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

(40)m=	0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.87	0.88	0.88

Average = Sum(40)$_{1...12}$ /12= 0.87 (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 2.33 (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 89.5 (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=	98.45	94.87	91.29	87.71	84.13	80.55	80.55	84.13	87.71	91.29	94.87	98.45

Total = Sum(44)$_{1...12}$ = 1074.01 (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=	146	127.69	131.77	114.88	110.23	95.12	88.14	101.14	102.35	119.28	130.2	141.39

Total = Sum(45)$_{1...12}$ = 1408.2 (45)

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

(46)m=	21.9	19.15	19.77	17.23	16.53	14.27	13.22	15.17	15.35	17.89	19.53	21.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	201.28	177.62	187.04	168.37	165.5	148.61	143.42	156.42	155.85	174.56	183.7	196.67	(62)

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

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

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

Output from water heater

(64)m=	201.28	177.62	187.04	168.37	165.5	148.61	143.42	156.42	155.85	174.56	183.7	196.67

Output from water heater (annual)$_{1...12}$ | 2059.04 | (64)

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

(65)m=	92.77	82.4	88.03	80.99	80.87	74.42	73.53	77.85	76.83	83.88	86.09	91.23	(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=	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	(66)

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

(67)m=	18.31	16.26	13.22	10.01	7.48	6.32	6.83	8.87	11.91	15.12	17.65	18.82	(67)

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

(68)m=	205.37	207.5	202.13	190.7	176.27	162.7	153.64	151.51	156.88	168.31	182.74	196.31	(68)

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

(69)m=	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	(71)

Water heating gains (Table 5)

(72)m=	124.69	122.62	118.33	112.49	108.7	103.36	98.83	104.64	106.7	112.74	119.57	122.63	(72)

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

(73)m=	406.29	404.31	391.61	371.13	350.38	330.31	317.22	322.95	333.42	354.11	377.89	395.68	(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)	
North	0.9x	0.77	x	3.8	x	10.63	x	0.48	x	0.7	=	9.41	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.48	x	0.7	=	17.98	(74)

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North	0.9x	0.77	x	3.8	x	34.53	x	0.48	x	0.7	=	30.55	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.48	x	0.7	=	49.08	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.48	x	0.7	=	66.11	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.48	x	0.7	=	70.77	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.48	x	0.7	=	66.08	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.48	x	0.7	=	52.42	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.48	x	0.7	=	36.73	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.48	x	0.7	=	21.4	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.48	x	0.7	=	11.61	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.48	x	0.7	=	7.84	(74)
East	0.9x	1	x	15.96	x	19.64	x	0.48	x	0.7	=	72.99	(76)
East	0.9x	1	x	15.96	x	38.42	x	0.48	x	0.7	=	142.78	(76)
East	0.9x	1	x	15.96	x	63.27	x	0.48	x	0.7	=	235.14	(76)
East	0.9x	1	x	15.96	x	92.28	x	0.48	x	0.7	=	342.94	(76)
East	0.9x	1	x	15.96	x	113.09	x	0.48	x	0.7	=	420.28	(76)
East	0.9x	1	x	15.96	x	115.77	x	0.48	x	0.7	=	430.23	(76)
East	0.9x	1	x	15.96	x	110.22	x	0.48	x	0.7	=	409.6	(76)
East	0.9x	1	x	15.96	x	94.68	x	0.48	x	0.7	=	351.84	(76)
East	0.9x	1	x	15.96	x	73.59	x	0.48	x	0.7	=	273.48	(76)
East	0.9x	1	x	15.96	x	45.59	x	0.48	x	0.7	=	169.42	(76)
East	0.9x	1	x	15.96	x	24.49	x	0.48	x	0.7	=	91.01	(76)
East	0.9x	1	x	15.96	x	16.15	x	0.48	x	0.7	=	60.02	(76)

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

(83)m=	82.4	160.76	265.69	392.01	486.39	501.01	475.67	404.26	310.21	190.82	102.61	67.87	(83)

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

(84)m=	488.69	565.07	657.3	763.14	836.77	831.32	792.9	727.21	643.63	544.93	480.5	463.55	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.93	0.83	0.66	0.48	0.35	0.4	0.64	0.89	0.97	0.99	(86)

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

(87)m=	19.88	20.08	20.39	20.73	20.92	20.99	21	21	20.95	20.67	20.21	19.84	(87)

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

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

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

(89)m=	0.98	0.97	0.92	0.8	0.62	0.42	0.29	0.33	0.58	0.87	0.97	0.99	(89)

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

(90)m=	18.68	18.97	19.41	19.88	20.11	20.19	20.2	20.2	20.16	19.81	19.17	18.63	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	19.11	19.37	19.76	20.19	20.4	20.48	20.49	20.49	20.44	20.12	19.54	19.07	(92)

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

(93)m=	19.11	19.37	19.76	20.19	20.4	20.48	20.49	20.49	20.44	20.12	19.54	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.91	0.8	0.63	0.44	0.31	0.35	0.6	0.86	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	477.41	541.42	598.73	609.7	525.19	366.34	244.81	256.15	384.15	470.74	460.79	454.76	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	968.13	943.27	862.61	724.47	557.25	371.27	245.55	257.48	402.74	609.34	800.81	961.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	365.09	270.04	196.33	82.63	23.85	0	0	0	0	103.12	244.82	377.19	

Total per year (kWh/year) = Sum(98)1...5,9...12 =	1663.08	(98)
Space heating requirement in kWh/m²/year	22.62	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1663.08	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1746.23	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2059.04	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2161.99	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	39.08	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f):				
mechanical ventilation - balanced, extract or positive input from outside			142.61	(330a)
warm air heating system fans			0	(330b)
pump for solar water heating			0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =		142.61	(331)
Energy for lighting (calculated in Appendix L)			323.34	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	943.21	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.28	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	963.5	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				963.5	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	74.02	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	167.81	(379)
Total CO2, kg/year	sum of (376)…(382) =				1205.33	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.39	(384)
EI rating (section 14)					86.37	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 GF-2

Address : GF-2, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	90.93	(1a)	x	2.4	(2a)	=	218.23	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.93	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	218.23	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			12.15	x1/[1/(1.4)+ 0.04]		=	16.11			(27)
Windows Type 2			7.63	x1/[1/(1.4)+ 0.04]		=	10.12			(27)
Floor			90.93	x	0.11	=	10.0023	110	10002.3	(28)
Walls Type1	77.99	21.88	56.11	x	0.15	=	8.42	14	785.54	(29)
Walls Type2	3.6	0	3.6	x	0.14	=	0.51	14	50.4	(29)
Walls Type3	4.8	0	4.8	x	0.15	=	0.72	14	67.2	(29)
Total area of elements, m²			177.32							(31)
Party wall			22.8	x	0	=	0	20	456	(32)
Party ceiling			90.93					30	2727.9	(32b)
Internal wall **			153.6					9	1382.4	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15471.74 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 170.15 (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 12.2 (36)

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

Total fabric heat loss (33) + (36) = 61.01 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.94	18.72	18.49	17.34	17.11	15.96	15.96	15.73	16.42	17.11	17.57	18.03	(38)

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

(39)m=	79.96	79.73	79.5	78.35	78.12	76.97	76.97	76.74	77.43	78.12	78.58	79.04	

Average = $Sum(39)_{1...12}$ /12= 78.29 (39)

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

(40)m=	0.88	0.88	0.87	0.86	0.86	0.85	0.85	0.84	0.85	0.86	0.86	0.87	

Average = $Sum(40)_{1...12}$ /12= 0.86 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.64 (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 96.86 (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=	106.54	102.67	98.8	94.92	91.05	87.17	87.17	91.05	94.92	98.8	102.67	106.54	

Total = $Sum(44)_{1...12}$ = 1162.3 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	158	138.19	142.6	124.32	119.29	102.94	95.39	109.46	110.76	129.09	140.91	153.02	

Total = $Sum(45)_{1...12}$ = 1523.96 (45)

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

(46)m=	23.7	20.73	21.39	18.65	17.89	15.44	14.31	16.42	16.61	19.36	21.14	22.95	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	213.28	188.12	197.88	177.81	174.57	156.43	150.66	164.73	164.26	184.36	194.4	208.29	(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=	213.28	188.12	197.88	177.81	174.57	156.43	150.66	164.73	164.26	184.36	194.4	208.29

Output from water heater (annual)$_{1…12}$ — 2174.8 (64)

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

(65)m=	96.76	85.89	91.64	84.13	83.89	77.02	75.94	80.62	79.62	87.14	89.65	95.1	(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=	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	(66)

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

(67)m=	21.48	19.08	15.52	11.75	8.78	7.41	8.01	10.41	13.98	17.75	20.71	22.08	(67)

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

(68)m=	240.78	243.28	236.98	223.58	206.66	190.75	180.13	177.63	183.93	197.33	214.25	230.15	(68)

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

(69)m=	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	(71)

Water heating gains (Table 5)

(72)m=	130.05	127.81	123.17	116.85	112.75	106.97	102.07	108.35	110.59	117.13	124.51	127.82	(72)

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

(73)m=	454.88	452.74	438.24	414.75	390.76	367.72	352.78	358.97	371.07	394.78	422.05	442.63	(73)

6. Solar gains:

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

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

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Southeast	0.9x	0.77	x	7.63	x	36.79	x	0.44	x	0.7	=	59.92	(77)
Southeast	0.9x	0.77	x	7.63	x	62.67	x	0.44	x	0.7	=	102.07	(77)
Southeast	0.9x	0.77	x	7.63	x	85.75	x	0.44	x	0.7	=	139.65	(77)
Southeast	0.9x	0.77	x	7.63	x	106.25	x	0.44	x	0.7	=	173.04	(77)
Southeast	0.9x	0.77	x	7.63	x	119.01	x	0.44	x	0.7	=	193.82	(77)
Southeast	0.9x	0.77	x	7.63	x	118.15	x	0.44	x	0.7	=	192.42	(77)
Southeast	0.9x	0.77	x	7.63	x	113.91	x	0.44	x	0.7	=	185.51	(77)
Southeast	0.9x	0.77	x	7.63	x	104.39	x	0.44	x	0.7	=	170.01	(77)
Southeast	0.9x	0.77	x	7.63	x	92.85	x	0.44	x	0.7	=	151.22	(77)
Southeast	0.9x	0.77	x	7.63	x	69.27	x	0.44	x	0.7	=	112.81	(77)
Southeast	0.9x	0.77	x	7.63	x	44.07	x	0.44	x	0.7	=	71.77	(77)
Southeast	0.9x	0.77	x	7.63	x	31.49	x	0.44	x	0.7	=	51.28	(77)
South	0.9x	0.77	x	12.15	x	46.75	x	0.44	x	0.7	=	121.24	(78)
South	0.9x	0.77	x	12.15	x	76.57	x	0.44	x	0.7	=	198.57	(78)
South	0.9x	0.77	x	12.15	x	97.53	x	0.44	x	0.7	=	252.94	(78)
South	0.9x	0.77	x	12.15	x	110.23	x	0.44	x	0.7	=	285.88	(78)
South	0.9x	0.77	x	12.15	x	114.87	x	0.44	x	0.7	=	297.9	(78)
South	0.9x	0.77	x	12.15	x	110.55	x	0.44	x	0.7	=	286.69	(78)
South	0.9x	0.77	x	12.15	x	108.01	x	0.44	x	0.7	=	280.11	(78)
South	0.9x	0.77	x	12.15	x	104.89	x	0.44	x	0.7	=	272.03	(78)
South	0.9x	0.77	x	12.15	x	101.89	x	0.44	x	0.7	=	264.22	(78)
South	0.9x	0.77	x	12.15	x	82.59	x	0.44	x	0.7	=	214.17	(78)
South	0.9x	0.77	x	12.15	x	55.42	x	0.44	x	0.7	=	143.72	(78)
South	0.9x	0.77	x	12.15	x	40.4	x	0.44	x	0.7	=	104.77	(78)

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

(83)m=	181.17	300.64	392.59	458.91	491.72	479.11	465.62	442.04	415.44	326.98	215.49	156.05	(83)

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

(84)m=	636.05	753.38	830.83	873.66	882.48	846.82	818.4	801.01	786.51	721.76	637.53	598.68	(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=	0.98	0.96	0.93	0.86	0.74	0.56	0.41	0.44	0.64	0.87	0.96	0.99	(86)

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

(87)m=	19.95	20.17	20.43	20.7	20.88	20.98	21	20.99	20.95	20.72	20.29	19.91	(87)

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

(88)m=	20.19	20.19	20.19	20.2	20.2	20.21	20.21	20.22	20.21	20.2	20.2	20.19	(88)

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

(89)m=	0.98	0.96	0.91	0.83	0.69	0.5	0.34	0.36	0.58	0.84	0.96	0.98	(89)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(90)m=	18.78	19.1	19.47	19.85	20.08	20.19	20.21	20.21	20.17	19.89	19.28	18.73		(90)

fLA = Living area ÷ (4) = 0.34 (91)

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

(92)m=	19.18	19.47	19.8	20.14	20.36	20.46	20.48	20.48	20.44	20.18	19.63	19.13	(92)

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

(93)m=	19.18	19.47	19.8	20.14	20.36	20.46	20.48	20.48	20.44	20.18	19.63	19.13	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.95	0.9	0.83	0.7	0.52	0.36	0.39	0.6	0.84	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	618.76	713.65	751.74	722.16	617.84	440.19	297.12	310.97	469.28	604.82	604.91	585.61	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1190.1	1161.88	1057.64	880.88	676.51	451.29	298.75	313.22	490.87	748.08	984.74	1180.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	425.07	301.21	227.59	114.28	43.66	0	0	0	0	106.59	273.47	442.44	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1934.31 (98)

Space heating requirement in kWh/m²/year 21.27 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1934.31	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2031.02	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2174.8	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2283.54	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	43.15	(313)

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Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		176.39	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	176.39	(331)
Energy for lighting (calculated in Appendix L)		379.38	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				89.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1041.28	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	22.39	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1063.67	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1063.67	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	91.54	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	196.9	(379)
Total CO2, kg/year	sum of (376)…(382) =				1352.11	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.87	(384)
EI rating (section 14)					86.67	(385)

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User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 House-11

Address : House-11, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	67.15	(1a)	x	2.4	(2a)	=	161.16	(3a)
First floor	61.15	(1b)	x	2.47	(2b)	=	151.04	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	128.3	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	312.2	(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) =	0.13	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.28	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.26	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.33	0.32	0.32	0.28	0.28	0.24	0.24	0.24	0.26	0.28	0.29	0.3

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=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(24d)

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

(25)m=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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			2.1	x	1.4	=	2.94			(26)
Windows Type 1			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 2			11.61	x1/[1/(1.4)+ 0.04]		=	15.39			(27)
Rooflights Type 1			4.05	x1/[1/(1.4) + 0.04]		=	5.67			(27b)
Rooflights Type 2			5.4	x1/[1/(1.4) + 0.04]		=	7.56			(27b)
Floor			67.15	x	0.13	=	8.7295	110	7386.5	(28)
Walls	104.64	16.59	88.05	x	0.15	=	13.21	150	13207.5	(29)
Roof Type1	40.31	0	40.31	x	0.11	=	4.43	9	362.79	(30)
Roof Type2	30.99	9.45	21.54	x	0.11	=	2.37	9	193.86	(30)
Total area of elements, m²			243.09							(31)
Party wall			39.55	x	0	=	0	70	2768.5	(32)
Internal wall **			216					9	1944	(32c)
Internal floor			61.15					18	1100.7	(32d)
Internal ceiling			61.15					9	550.35	(32e)

** 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) = 63.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27514.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 214.45 (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 — 19.78 (36)

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

Total fabric heat loss (33) + (36) = 83.19 (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=	57.06	56.84	56.63	55.64	55.45	54.59	54.59	54.43	54.92	55.45	55.83	56.22	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(39)m=	140.25	140.03	139.82	138.83	138.65	137.78	137.78	137.62	138.12	138.65	139.02	139.41

Average = Sum(39)$_{1\ldots12}$ /12= 138.83 (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=	1.09	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.08	1.08	1.08	1.09

Average = Sum(40)$_{1\ldots12}$ /12= 1.08 (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 — 2.89 (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 — 102.85 (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=	113.13	109.02	104.91	100.79	96.68	92.56	92.56	96.68	100.79	104.91	109.02	113.13

Total = Sum(44)$_{1\ldots12}$ = 1234.18 (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=	167.77	146.74	151.42	132.01	126.67	109.3	101.29	116.23	117.61	137.07	149.62	162.48

Total = Sum(45)$_{1\ldots12}$ = 1618.2 (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=	25.17	22.01	22.71	19.8	19	16.4	15.19	17.43	17.64	20.56	22.44	24.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

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

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

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.96	46.03	50.96	49.32	49.27	45.65	47.17	49.27	49.32	50.96	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=	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44	(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=	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44	

Output from water heater (annual)$_{1...12}$ 2207.36 (64)

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

(65)m=	68.52	60.3	63.09	56.22	54.43	47.76	45.47	50.96	51.44	58.32	62.08	66.76	(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=	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	(66)

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

(67)m=	26.52	23.56	19.16	14.5	10.84	9.15	9.89	12.86	17.25	21.91	25.57	27.26	(67)

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

(68)m=	295.66	298.73	291	274.54	253.76	234.23	221.19	218.12	225.85	242.31	263.09	282.61	(68)

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

(69)m=	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	(71)

Water heating gains (Table 5)

(72)m=	92.1	89.73	84.79	78.09	73.16	66.33	61.12	68.5	71.44	78.38	86.22	89.74	(72)

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

(73)m=	483.64	481.37	464.3	436.48	407.12	379.07	361.55	368.83	383.9	411.96	444.23	468.97	(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)	
East	0.9x	1	x	2.88	x	19.64	x	0.76	x	0.7	=	20.85	(76)
East	0.9x	1	x	2.88	x	38.42	x	0.76	x	0.7	=	40.79	(76)
East	0.9x	1	x	2.88	x	63.27	x	0.76	x	0.7	=	67.18	(76)
East	0.9x	1	x	2.88	x	92.28	x	0.76	x	0.7	=	97.98	(76)
East	0.9x	1	x	2.88	x	113.09	x	0.76	x	0.7	=	120.08	(76)
East	0.9x	1	x	2.88	x	115.77	x	0.76	x	0.7	=	122.92	(76)
East	0.9x	1	x	2.88	x	110.22	x	0.76	x	0.7	=	117.03	(76)
East	0.9x	1	x	2.88	x	94.68	x	0.76	x	0.7	=	100.53	(76)
East	0.9x	1	x	2.88	x	73.59	x	0.76	x	0.7	=	78.14	(76)
East	0.9x	1	x	2.88	x	45.59	x	0.76	x	0.7	=	48.41	(76)
East	0.9x	1	x	2.88	x	24.49	x	0.76	x	0.7	=	26	(76)
East	0.9x	1	x	2.88	x	16.15	x	0.76	x	0.7	=	17.15	(76)
West	0.9x	0.77	x	11.61	x	19.64	x	0.76	x	0.7	=	84.07	(80)
West	0.9x	0.77	x	11.61	x	38.42	x	0.76	x	0.7	=	164.45	(80)
West	0.9x	0.77	x	11.61	x	63.27	x	0.76	x	0.7	=	270.83	(80)
West	0.9x	0.77	x	11.61	x	92.28	x	0.76	x	0.7	=	394.99	(80)
West	0.9x	0.77	x	11.61	x	113.09	x	0.76	x	0.7	=	484.07	(80)
West	0.9x	0.77	x	11.61	x	115.77	x	0.76	x	0.7	=	495.54	(80)
West	0.9x	0.77	x	11.61	x	110.22	x	0.76	x	0.7	=	471.77	(80)
West	0.9x	0.77	x	11.61	x	94.68	x	0.76	x	0.7	=	405.24	(80)
West	0.9x	0.77	x	11.61	x	73.59	x	0.76	x	0.7	=	314.99	(80)
West	0.9x	0.77	x	11.61	x	45.59	x	0.76	x	0.7	=	195.14	(80)
West	0.9x	0.77	x	11.61	x	24.49	x	0.76	x	0.7	=	104.82	(80)
West	0.9x	0.77	x	11.61	x	16.15	x	0.76	x	0.7	=	69.13	(80)
Rooflights	0.9x	1	x	4.05	x	26.61	x	0.76	x	0.7	=	51.6	(82)
Rooflights	0.9x	1	x	5.4	x	26.61	x	0.76	x	0.7	=	68.79	(82)
Rooflights	0.9x	1	x	4.05	x	53.79	x	0.76	x	0.7	=	104.31	(82)
Rooflights	0.9x	1	x	5.4	x	53.79	x	0.76	x	0.7	=	139.08	(82)
Rooflights	0.9x	1	x	4.05	x	92.95	x	0.76	x	0.7	=	180.24	(82)
Rooflights	0.9x	1	x	5.4	x	92.95	x	0.76	x	0.7	=	240.31	(82)
Rooflights	0.9x	1	x	4.05	x	142.44	x	0.76	x	0.7	=	276.21	(82)
Rooflights	0.9x	1	x	5.4	x	142.44	x	0.76	x	0.7	=	368.28	(82)
Rooflights	0.9x	1	x	4.05	x	180.71	x	0.76	x	0.7	=	350.43	(82)
Rooflights	0.9x	1	x	5.4	x	180.71	x	0.76	x	0.7	=	467.24	(82)
Rooflights	0.9x	1	x	4.05	x	187.72	x	0.76	x	0.7	=	364.02	(82)
Rooflights	0.9x	1	x	5.4	x	187.72	x	0.76	x	0.7	=	485.36	(82)
Rooflights	0.9x	1	x	4.05	x	177.6	x	0.76	x	0.7	=	344.39	(82)
Rooflights	0.9x	1	x	5.4	x	177.6	x	0.76	x	0.7	=	459.18	(82)
Rooflights	0.9x	1	x	4.05	x	148.43	x	0.76	x	0.7	=	287.83	(82)

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Rooflights 0.9x	1	x	5.4	x	148.43	x	0.76	x	0.7	=	383.77	(82)
Rooflights 0.9x	1	x	4.05	x	110.34	x	0.76	x	0.7	=	213.96	(82)
Rooflights 0.9x	1	x	5.4	x	110.34	x	0.76	x	0.7	=	285.28	(82)
Rooflights 0.9x	1	x	4.05	x	64.97	x	0.76	x	0.7	=	125.99	(82)
Rooflights 0.9x	1	x	5.4	x	64.97	x	0.76	x	0.7	=	167.99	(82)
Rooflights 0.9x	1	x	4.05	x	33.49	x	0.76	x	0.7	=	64.94	(82)
Rooflights 0.9x	1	x	5.4	x	33.49	x	0.76	x	0.7	=	86.58	(82)
Rooflights 0.9x	1	x	4.05	x	21.68	x	0.76	x	0.7	=	42.04	(82)
Rooflights 0.9x	1	x	5.4	x	21.68	x	0.76	x	0.7	=	56.06	(82)

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

(83)m=	225.31	448.64	758.56	1137.47	1421.82	1467.84	1392.37	1177.37	892.36	537.52	282.35	184.38	(83)

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

(84)m=	708.95	930	1222.87	1573.95	1828.94	1846.91	1753.92	1546.2	1276.26	949.48	726.58	653.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.85	0.66	0.47	0.34	0.41	0.69	0.95	0.99	1	(86)

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

(87)m=	19.64	19.89	20.29	20.71	20.93	20.99	21	21	20.94	20.55	19.99	19.59	(87)

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

(88)m=	20.01	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	20.01	(88)

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

(89)m=	1	0.99	0.95	0.82	0.6	0.4	0.27	0.32	0.61	0.93	0.99	1	(89)

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

(90)m=	18.76	19.01	19.4	19.8	19.97	20.02	20.02	20.02	19.99	19.66	19.12	18.71	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	18.98	19.23	19.63	20.03	20.22	20.26	20.27	20.27	20.23	19.89	19.34	18.94	(92)

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

(93)m=	18.83	19.08	19.48	19.88	20.07	20.11	20.12	20.12	20.08	19.74	19.19	18.79	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.98	0.94	0.81	0.6	0.41	0.28	0.33	0.61	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	705.47	915.15	1151.36	1275.34	1105.37	752.93	484.3	510.14	784.54	872.75	718.26	651.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2038.12	1986.09	1814.52	1524.66	1159.98	759.87	485.14	512.04	825.88	1266.75	1680.54	2033.72	(97)

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

(98)m=	991.49	719.67	493.39	179.51	40.63	0	0	0	0	293.14	692.84	1028.67

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4439.33 (98)

Space heating requirement in kWh/m²/year 34.6 (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		90.3	(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)	991.49	719.67	493.39	179.51	40.63	0	0	0	0	293.14	692.84	1028.67		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1098	796.98	546.39	198.79	44.99	0	0	0	0	324.62	767.27	1139.17		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4916.2	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44		
Efficiency of water heater													81	(216)
(217)m=	88.46	88.16	87.38	85.37	82.6	81	81	81	81	86.42	88.04	88.55		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	247.25	218.65	231.6	212.39	213	191.3	183.28	204.31	206.09	217.57	225.95	241.03		
Total = Sum(219a)$_{1...12}$ =													2592.41	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			4916.2	
Water heating fuel used			2592.41	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			468.38	(232)

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

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

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Space heating (main system 1)	(211) x	0.216	=	1061.9	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	559.96	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1621.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	243.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		1880.52	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.66	(273)
EI rating (section 14)				85	(274)

APPENDIX B2

SAP OUTPUTS FOR SAMPLE UNITS

“CLEAN”

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 1F-3

Address : 1F-3, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.75	(1a) x	2.4	(2a) =	169.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.75	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		169.8	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.8	x1/[1/(1.4)+ 0.04]		=	5.04			(27)
Windows Type 2			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Walls Type1	47.64	21.86	25.78	x	0.15	=	3.87	14	360.92	(29)
Walls Type2	8.02	0	8.02	x	0.14	=	1.13	14	112.28	(29)
Total area of elements, m²			55.66							(31)
Party wall			31.51	x	0	=	0	20	630.2	(32)
Party floor			70.75					40	2830	(32a)
Party ceiling			70.75					30	2122.5	(32b)
Internal wall **			105.6					9	950.4	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7006.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 99.03 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.36 (36)

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

Total fabric heat loss (33) + (36) = 39.5 (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

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(38)m=	14.74	14.56	14.38	13.49	13.31	12.42	12.42	12.24	12.78	13.31	13.67	14.03	(38)

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

(39)m=	54.24	54.06	53.88	52.99	52.81	51.92	51.92	51.74	52.27	52.81	53.17	53.52	

Average = $\text{Sum}(39)_{1...12}$ /12= 52.94 (39)

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

(40)m=	0.77	0.76	0.76	0.75	0.75	0.73	0.73	0.73	0.74	0.75	0.75	0.76

Average = $\text{Sum}(40)_{1...12}$ /12= 0.75 (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 2.26 (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 87.97 (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=	96.77	93.25	89.73	86.22	82.7	79.18	79.18	82.7	86.22	89.73	93.25	96.77

Total = $\text{Sum}(44)_{1...12}$ = 1055.7 (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=	143.51	125.51	129.52	112.92	108.35	93.5	86.64	99.42	100.61	117.25	127.98	138.98

Total = $\text{Sum}(45)_{1...12}$ = 1384.18 (45)

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

(46)m=	21.53	18.83	19.43	16.94	16.25	14.02	13	14.91	15.09	17.59	19.2	20.85	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	198.79	175.44	184.8	166.41	163.63	146.99	141.91	154.7	154.1	172.52	181.48	194.26	(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=	198.79	175.44	184.8	166.41	163.63	146.99	141.91	154.7	154.1	172.52	181.48	194.26

Output from water heater (annual)$_{1...12}$ | 2035.02 | (64)

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

(65)m=	91.94	81.68	87.29	80.34	80.25	73.88	73.03	77.28	76.25	83.21	85.35	90.43	(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=	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	(66)

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

(67)m=	17.74	15.76	12.82	9.7	7.25	6.12	6.62	8.6	11.54	14.66	17.11	18.24	(67)

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

(68)m=	199.04	201.11	195.9	184.82	170.83	157.69	148.91	146.84	152.05	163.13	177.11	190.26	(68)

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

(69)m=	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	(71)

Water heating gains (Table 5)

(72)m=	123.57	121.54	117.32	111.58	107.86	102.61	98.16	103.87	105.9	111.84	118.54	121.55	(72)

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

(73)m=	397.32	395.37	383	363.07	342.91	323.39	310.64	316.27	326.45	346.58	369.73	387.01	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.8	x	10.63	x	0.558	x	0.7	=	10.94	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.558	x	0.7	=	20.9	(74)

North	0.9x	0.77	x	3.8	x	34.53	x	0.558	x	0.7	=	35.52	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.558	x	0.7	=	57.05	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.558	x	0.7	=	76.85	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.558	x	0.7	=	82.27	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.558	x	0.7	=	76.81	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.558	x	0.7	=	60.94	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.558	x	0.7	=	42.7	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.558	x	0.7	=	24.88	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.558	x	0.7	=	13.49	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.558	x	0.7	=	9.12	(74)
West	0.9x	0.77	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(80)
West	0.9x	0.77	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(80)
West	0.9x	0.77	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(80)
West	0.9x	0.77	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(80)
West	0.9x	0.77	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(80)
West	0.9x	0.77	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(80)
West	0.9x	0.77	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(80)
West	0.9x	0.77	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(80)
West	0.9x	0.77	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(80)
West	0.9x	0.77	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(80)
West	0.9x	0.77	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(80)
West	0.9x	0.77	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(80)

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

(83)m=	95.79	186.88	308.87	455.71	565.43	582.42	552.97	469.95	360.62	221.83	119.29	78.89	(83)

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

(84)m=	493.11	582.26	691.87	818.79	908.34	905.81	863.61	786.23	687.07	568.42	489.01	465.9	(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=	0.94	0.9	0.82	0.67	0.51	0.36	0.26	0.3	0.5	0.76	0.9	0.95	(86)

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

(87)m=	19.7	19.98	20.37	20.73	20.91	20.98	21	20.99	20.94	20.66	20.12	19.65	(87)

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

(88)m=	20.28	20.28	20.29	20.3	20.3	20.31	20.31	20.31	20.31	20.3	20.3	20.29	(88)

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

(89)m=	0.93	0.89	0.8	0.65	0.48	0.32	0.22	0.26	0.45	0.73	0.89	0.94	(89)

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

(90)m=	18.53	18.93	19.47	19.97	20.21	20.29	20.31	20.31	20.25	19.89	19.15	18.47	(90)

fLA = Living area ÷ (4) = | 0.35 | (91)

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

(92)m=	18.94	19.3	19.79	20.24	20.46	20.54	20.55	20.55	20.5	20.16	19.49	18.89	(92)

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

(93)m=	18.94	19.3	19.79	20.24	20.46	20.54	20.55	20.55	20.5	20.16	19.49	18.89	(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=	0.91	0.87	0.79	0.64	0.48	0.34	0.24	0.27	0.47	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	450.78	506.49	543.95	527.39	439.31	303.51	204.1	213.06	319.76	413.59	427.41	430.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	794.29	778.57	715.99	601.05	462.46	308.22	205.12	214.71	334.31	504.86	658.81	786.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	255.57	182.84	128	53.03	17.22	0	0	0	0	67.91	166.61	264.3	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1135.49 (98)

Space heating requirement in kWh/m²/year 16.05 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1135.49	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	715.36	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	476.91	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2035.02	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1282.06	(310a)

DER WorkSheet: New dwelling design stage

Water heat from heat source 2	(64) x (303b) x (305) x (306) =	854.71	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.29	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		137.24	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	137.24	(331)
Energy for lighting (calculated in Appendix L)		313.38	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1556.82	x	0.22		336.27	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	462.84	x	0.52		-240.22	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2790.13	x	0.22		602.67	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	829.51	x	0.52		-430.51	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	316.08	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	17.28	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	601.57	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					601.57	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	71.23	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	162.64	(379)
Total CO2, kg/year	sum of (376)…(382) =					835.44	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					11.81	(384)
EI rating (section 14)						90.33	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 1F-4

Address : 1F-4, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	58.06	(1a) x	2.4	(2a) =	139.34	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	58.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.34	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.9	(23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Windows Type 2			2.4	x1/[1/(1.4)+ 0.04]		=	3.18			(27)
Floor			58.06	x	0.2	=	11.612	75	4354.5	(28)
Walls Type1	30.84	20.46	10.38	x	0.15	=	1.56	14	145.32	(29)
Walls Type2	24.12	0	24.12	x	0.14	=	3.4	14	337.68	(29)
Walls Type3	9.6	0	9.6	x	0.15	=	1.44	14	134.4	(29)
Total area of elements, m²			122.62							(31)
Party wall			16.32	x	0	=	0	20	326.4	(32)
Party ceiling			58.06					30	1741.8	(32b)
Internal wall **			81.6					9	734.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	45.29	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7774.5	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	133.9	(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		13.72	(36)

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

Total fabric heat loss	(33) + (36) =	59.01	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	11.44	11.3	11.17	10.5	10.37	9.7	9.7	9.57	9.97	10.37	10.64	10.9	(38)

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

(39)m=	70.45	70.31	70.18	69.51	69.38	68.71	68.71	68.58	68.98	69.38	69.64	69.91	

Average = Sum(39)$_{1…12}$ /12= 69.48 (39)

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

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2	

Average = Sum(40)$_{1…12}$ /12= 1.2 (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 1.93 (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 79.95 (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=	87.94	84.75	81.55	78.35	75.15	71.95	71.95	75.15	78.35	81.55	84.75	87.94

Total = Sum(44)$_{1…12}$ = 959.39 (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=	130.42	114.07	117.7	102.62	98.46	84.97	78.73	90.35	91.43	106.55	116.31	126.3

Total = Sum(45)$_{1…12}$ = 1257.91 (45)

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

(46)m=	19.56	17.11	17.66	15.39	14.77	12.75	11.81	13.55	13.71	15.98	17.45	18.95	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	185.7	163.99	172.98	156.11	153.74	138.46	134.01	145.63	144.92	161.83	169.8	181.58	(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=	185.7	163.99	172.98	156.11	153.74	138.46	134.01	145.63	144.92	161.83	169.8	181.58

Output from water heater (annual)$_{1...12}$ | 1908.75 | (64)

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

(65)m=	87.59	77.87	83.36	76.92	76.96	71.05	70.4	74.26	73.19	79.65	81.47	86.22	(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=	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	(66)

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

(67)m=	14.98	13.31	10.82	8.19	6.12	5.17	5.59	7.26	9.75	12.37	14.44	15.4	(67)

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

(68)m=	168.03	169.77	165.38	156.02	144.22	133.12	125.71	123.96	128.36	137.71	149.52	160.62	(68)

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

(69)m=	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	(71)

Water heating gains (Table 5)

(72)m=	117.72	115.88	112.04	106.83	103.44	98.68	94.62	99.82	101.66	107.06	113.15	115.88	(72)

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

(73)m=	352.63	350.85	340.13	322.94	305.68	288.86	277.81	282.93	291.66	309.03	329	343.79	(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)

North	0.9x	0.77	x	2.4	x	10.63	x	0.558	x	0.7	=	6.91	(74)
North	0.9x	0.77	x	2.4	x	20.32	x	0.558	x	0.7	=	13.2	(74)
North	0.9x	0.77	x	2.4	x	34.53	x	0.558	x	0.7	=	22.43	(74)
North	0.9x	0.77	x	2.4	x	55.46	x	0.558	x	0.7	=	36.03	(74)
North	0.9x	0.77	x	2.4	x	74.72	x	0.558	x	0.7	=	48.54	(74)
North	0.9x	0.77	x	2.4	x	79.99	x	0.558	x	0.7	=	51.96	(74)
North	0.9x	0.77	x	2.4	x	74.68	x	0.558	x	0.7	=	48.51	(74)
North	0.9x	0.77	x	2.4	x	59.25	x	0.558	x	0.7	=	38.49	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.558	x	0.7	=	26.97	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.558	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.558	x	0.7	=	8.52	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.558	x	0.7	=	5.76	(74)
East	0.9x	1	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(76)
East	0.9x	1	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(76)
East	0.9x	1	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(76)
East	0.9x	1	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(76)
East	0.9x	1	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(76)
East	0.9x	1	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(76)
East	0.9x	1	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(76)
East	0.9x	1	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(76)
East	0.9x	1	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(76)
East	0.9x	1	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(76)
East	0.9x	1	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(76)
East	0.9x	1	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(76)

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

(83)m=	91.76	179.18	295.78	434.7	537.12	552.11	524.67	447.5	344.89	212.67	114.32	75.53	(83)

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

(84)m=	444.38	530.03	635.92	757.63	842.79	840.97	802.48	730.43	636.54	521.7	443.32	419.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.94	0.9	0.79	0.65	0.49	0.37	0.41	0.64	0.86	0.95	0.97	(86)

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

(87)m=	19.13	19.41	19.87	20.39	20.75	20.92	20.98	20.97	20.82	20.31	19.62	19.07	(87)

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

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.92	(88)

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

(89)m=	0.96	0.93	0.88	0.76	0.59	0.42	0.28	0.32	0.57	0.83	0.94	0.97	(89)

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

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(90)m=	17.44	17.85	18.5	19.22	19.67	19.87	19.92	19.92	19.77	19.13	18.16	17.36	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	18.26	18.61	19.17	19.79	20.19	20.39	20.44	20.43	20.29	19.71	18.87	18.2	(92)

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

(93)m=	18.26	18.61	19.17	19.79	20.19	20.39	20.44	20.43	20.29	19.71	18.87	18.2	(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=	0.95	0.92	0.86	0.75	0.61	0.45	0.32	0.37	0.59	0.82	0.92	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.77	487.76	548.26	571.29	512.42	375.91	257.88	267.63	375.83	428.59	409.68	400.79	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	983.55	964.32	889.21	756.99	589.29	397.53	263.58	276.22	426.63	631.9	819.89	978.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	417.96	320.25	253.67	133.7	57.19	0	0	0	0	151.26	295.35	429.78	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2059.16 (98)

Space heating requirement in kWh/m²/year 35.47 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2059.16	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1297.27	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	864.85	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement 1908.75

If DHW from community scheme:

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Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1202.51	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	801.68	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	41.66	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		112.62	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	112.62	(331)
Energy for lighting (calculated in Appendix L)		264.55	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2823.22	x	0.22		609.82	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	839.34	x	0.52		-435.62	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2617.01	x	0.22		565.27	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	778.04	x	0.52		-403.8	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	395.57	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	21.62	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	752.86	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					752.86	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	58.45	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	137.3	(379)
Total CO2, kg/year	sum of (376)…(382) =					948.62	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					16.34	(384)
EI rating (section 14)						87.67	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 2F-5

Address : 2F-5, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.45	(1a) x	2.4	(2a) =	121.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.45	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		121.08	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			12.17	x1/[1/(1.4)+ 0.04]		=	16.13			(27)
Windows Type 2			1.68	x1/[1/(1.4)+ 0.04]		=	2.23			(27)
Walls Type1	30.27	15.95	14.32	x	0.15	=	2.15	14	200.48	(29)
Walls Type2	34.06	0	34.06	x	0.14	=	4.8	14	476.84	(29)
Total area of elements, m²			64.33							(31)
Party wall			10.8	x	0	=	0	20	216	(32)
Party floor			50.45					40	2018	(32a)
Party ceiling			50.45					30	1513.5	(32b)
Internal wall **			76.8					9	691.2	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.25 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5116.02 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 101.41 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.65 (36)

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

Total fabric heat loss (33) + (36) = 33.9 (37)

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

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

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(38)m=	9.94	9.82	9.71	9.13	9.01	8.43	8.43	8.31	8.66	9.01	9.24	9.47	(38)

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

(39)m=	43.84	43.72	43.61	43.03	42.91	42.33	42.33	42.22	42.56	42.91	43.14	43.38	

Average = Sum(39)$_{1…12}$ /12= 43 (39)

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

(40)m=	0.87	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = Sum(40)$_{1…12}$ /12= 0.85 (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 1.7 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.65 (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=	82.12	79.13	76.15	73.16	70.18	67.19	67.19	70.18	73.16	76.15	79.13	82.12	

Total = Sum(44)$_{1…12}$ = 895.86 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.78	106.51	109.91	95.82	91.94	79.34	73.52	84.37	85.37	99.49	108.61	117.94	

Total = Sum(45)$_{1…12}$ = 1174.61 (45)

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

(46)m=	18.27	15.98	16.49	14.37	13.79	11.9	11.03	12.65	12.81	14.92	16.29	17.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	177.06	156.44	165.19	149.32	147.22	132.83	128.8	139.64	138.87	154.77	162.1	173.22	(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=	177.06	156.44	165.19	149.32	147.22	132.83	128.8	139.64	138.87	154.77	162.1	173.22

Output from water heater (annual)$_{1...12}$ | 1825.45 | (64)

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

(65)m=	84.71	75.36	80.77	74.66	74.79	69.18	68.67	72.27	71.18	77.3	78.91	83.44	(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=	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	(66)

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

(67)m=	13.23	11.75	9.56	7.23	5.41	4.57	4.93	6.41	8.61	10.93	12.76	13.6	(67)

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

(68)m=	148.4	149.94	146.06	137.8	127.37	117.57	111.02	109.48	113.36	121.62	132.05	141.85	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	(71)

Water heating gains (Table 5)

(72)m=	113.86	112.14	108.56	103.69	100.53	96.08	92.29	97.14	98.86	103.9	109.59	112.15	(72)

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

(73)m=	324.05	322.38	312.73	297.27	281.86	266.76	256.8	261.59	269.38	285.01	302.95	316.15	(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)	
North	0.9x	0.77	x	1.68	x	10.63	x	0.558	x	0.7	=	4.84	(74)
North	0.9x	0.77	x	1.68	x	20.32	x	0.558	x	0.7	=	9.24	(74)

North	0.9x	0.77	x	1.68	x	34.53	x	0.558	x	0.7	=	15.7	(74)
North	0.9x	0.77	x	1.68	x	55.46	x	0.558	x	0.7	=	25.22	(74)
North	0.9x	0.77	x	1.68	x	74.72	x	0.558	x	0.7	=	33.98	(74)
North	0.9x	0.77	x	1.68	x	79.99	x	0.558	x	0.7	=	36.37	(74)
North	0.9x	0.77	x	1.68	x	74.68	x	0.558	x	0.7	=	33.96	(74)
North	0.9x	0.77	x	1.68	x	59.25	x	0.558	x	0.7	=	26.94	(74)
North	0.9x	0.77	x	1.68	x	41.52	x	0.558	x	0.7	=	18.88	(74)
North	0.9x	0.77	x	1.68	x	24.19	x	0.558	x	0.7	=	11	(74)
North	0.9x	0.77	x	1.68	x	13.12	x	0.558	x	0.7	=	5.97	(74)
North	0.9x	0.77	x	1.68	x	8.86	x	0.558	x	0.7	=	4.03	(74)
East	0.9x	1	x	12.17	x	19.64	x	0.56	x	0.7	=	64.7	(76)
East	0.9x	1	x	12.17	x	38.42	x	0.56	x	0.7	=	126.57	(76)
East	0.9x	1	x	12.17	x	63.27	x	0.56	x	0.7	=	208.44	(76)
East	0.9x	1	x	12.17	x	92.28	x	0.56	x	0.7	=	303.99	(76)
East	0.9x	1	x	12.17	x	113.09	x	0.56	x	0.7	=	372.56	(76)
East	0.9x	1	x	12.17	x	115.77	x	0.56	x	0.7	=	381.38	(76)
East	0.9x	1	x	12.17	x	110.22	x	0.56	x	0.7	=	363.09	(76)
East	0.9x	1	x	12.17	x	94.68	x	0.56	x	0.7	=	311.89	(76)
East	0.9x	1	x	12.17	x	73.59	x	0.56	x	0.7	=	242.42	(76)
East	0.9x	1	x	12.17	x	45.59	x	0.56	x	0.7	=	150.18	(76)
East	0.9x	1	x	12.17	x	24.49	x	0.56	x	0.7	=	80.67	(76)
East	0.9x	1	x	12.17	x	16.15	x	0.56	x	0.7	=	53.21	(76)

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

(83)m=	69.54	135.81	224.14	329.22	406.53	417.75	397.05	338.83	261.3	161.18	86.64	57.24	(83)

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

(84)m=	393.58	458.19	536.87	626.49	688.39	684.51	653.85	600.42	530.69	446.19	389.59	373.39	(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	0.89	0.82	0.69	0.53	0.38	0.28	0.32	0.51	0.76	0.89	0.94	(86)

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

(87)m=	19.58	19.85	20.25	20.65	20.87	20.97	20.99	20.99	20.92	20.58	20.02	19.52	(87)

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

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

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

(89)m=	0.92	0.88	0.8	0.66	0.5	0.34	0.23	0.27	0.46	0.73	0.88	0.93	(89)

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

(90)m=	18.29	18.68	19.24	19.78	20.07	20.19	20.21	20.21	20.14	19.72	18.93	18.22	(90)

fLA = Living area ÷ (4) = | 0.53 | (91)

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

(92)m=	18.97	19.3	19.77	20.24	20.49	20.6	20.62	20.62	20.55	20.17	19.5	18.91	(92)

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

(93)m=	18.97	19.3	19.77	20.24	20.49	20.6	20.62	20.62	20.55	20.17	19.5	18.91	(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	0.86	0.79	0.66	0.51	0.36	0.26	0.29	0.49	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	356.41	396.05	423.06	413.33	350.38	247.38	168.63	175.66	257.54	325.69	337.39	341.9	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	642.99	629.51	578.65	487.85	377.3	253.92	170.25	178.1	274.35	410.78	535.12	637.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	213.21	156.89	115.76	53.65	20.03	0	0	0	0	63.31	142.37	220.21	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	985.44	(98)
Space heating requirement in kWh/m²/year	19.53	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		985.44	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	620.82	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	413.88	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1825.45	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1150.03	(310a)

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Water heat from heat source 2	(64) x (303b) x (305) x (306) =	766.69	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.51	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		97.86	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	97.86	(331)
Energy for lighting (calculated in Appendix L)		233.65	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1351.09	x	0.22		291.84	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	401.68	x	0.52		-208.47	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2502.79	x	0.22		540.6	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	744.08	x	0.52		-386.18	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	280.22	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	15.32	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	533.33	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					533.33	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	50.79	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	121.26	(379)
Total CO2, kg/year	sum of (376)…(382) =					705.39	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					13.98	(384)
EI rating (section 14)						90.1	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 2F-6

Address : 2F-6, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	73.35	(1a)	x	2.4	(2a)	=	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.35	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	176.04	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Walls Type1	33.84	18.06	15.78	x	0.15	=	2.37	14	220.92	(29)
Walls Type2	13.51	0	13.51	x	0.14	=	1.9	14	189.14	(29)
Walls Type3	13.82	0	13.82	x	0.15	=	2.07	14	193.48	(29)
Total area of elements, m²			61.17							(31)
Party wall			21.19	x	0	=	0	20	423.8	(32)
Party floor			73.35					40	2934	(32a)
Party ceiling			73.35					30	2200.5	(32b)
Internal wall **			105.6					9	950.4	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7112.24 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 96.96 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.02 (36)

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

Total fabric heat loss (33) + (36) = 36.46 (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=	14.45	14.28	14.11	13.27	13.1	12.25	12.25	12.09	12.59	13.1	13.44	13.77	(38)

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

(39)m=	50.91	50.74	50.57	49.73	49.56	48.72	48.72	48.55	49.05	49.56	49.9	50.23	

Average = $Sum(39)_{1...12}$ /12= 49.69 (39)

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

(40)m=	0.69	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.67	0.68	0.68	0.68

Average = $Sum(40)_{1...12}$ /12= 0.68 (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 2.32 (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 89.41 (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=	98.35	94.77	91.2	87.62	84.05	80.47	80.47	84.05	87.62	91.2	94.77	98.35

Total = $Sum(44)_{1...12}$ = 1072.92 (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=	145.85	127.56	131.63	114.76	110.12	95.02	88.05	101.04	102.25	119.16	130.07	141.25

Total = $Sum(45)_{1...12}$ = 1406.77 (45)

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

(46)m=	21.88	19.13	19.75	17.21	16.52	14.25	13.21	15.16	15.34	17.87	19.51	21.19	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	201.13	177.49	186.91	168.25	165.39	148.52	143.33	156.32	155.74	174.44	183.57	196.53	(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=	201.13	177.49	186.91	168.25	165.39	148.52	143.33	156.32	155.74	174.44	183.57	196.53	

Output from water heater (annual)$_{1…12}$ | 2057.61 | (64)

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

(65)m=	92.72	82.36	87.99	80.95	80.84	74.39	73.5	77.82	76.79	83.84	86.04	91.19	(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=	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	(66)

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

(67)m=	18.29	16.24	13.21	10	7.48	6.31	6.82	8.86	11.9	15.11	17.63	18.8	(67)

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

(68)m=	204.99	207.11	201.75	190.34	175.94	162.4	153.35	151.23	156.59	168	182.4	195.94	(68)

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

(69)m=	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	(71)

Water heating gains (Table 5)

(72)m=	124.62	122.55	118.27	112.43	108.65	103.32	98.79	104.59	106.66	112.69	119.51	122.56	(72)

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

(73)m=	405.76	403.78	391.1	370.65	349.93	329.9	316.83	322.55	333.01	353.67	377.41	395.17	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(80)
West	0.9x	0.77	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(80)

West	0.9x	0.77	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(80)
West	0.9x	0.77	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(80)
West	0.9x	0.77	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(80)
West	0.9x	0.77	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(80)
West	0.9x	0.77	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(80)
West	0.9x	0.77	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(80)
West	0.9x	0.77	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(80)
West	0.9x	0.77	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(80)
West	0.9x	0.77	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(80)
West	0.9x	0.77	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(80)

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

(83)m=	84.85	165.98	273.35	398.66	488.58	500.15	476.16	409.01	317.92	196.95	105.8	69.78	(83)

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

(84)m=	490.61	569.76	664.45	769.31	838.51	830.04	792.99	731.57	650.93	550.62	483.21	464.95	(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=	0.94	0.9	0.82	0.68	0.52	0.37	0.27	0.3	0.5	0.76	0.9	0.94	(86)

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

(87)m=	19.84	20.1	20.44	20.77	20.93	20.98	21	20.99	20.95	20.71	20.23	19.8	(87)

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

(88)m=	20.35	20.35	20.35	20.36	20.36	20.37	20.37	20.37	20.37	20.36	20.36	20.35	(88)

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

(89)m=	0.93	0.89	0.8	0.66	0.49	0.33	0.23	0.26	0.46	0.73	0.89	0.94	(89)

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

(90)m=	18.78	19.14	19.63	20.07	20.28	20.36	20.37	20.37	20.32	20.01	19.35	18.72	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	19.2	19.52	19.95	20.35	20.53	20.6	20.62	20.62	20.57	20.28	19.69	19.15	(92)

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

(93)m=	19.2	19.52	19.95	20.35	20.53	20.6	20.62	20.62	20.57	20.28	19.69	19.15	(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	0.87	0.79	0.65	0.5	0.35	0.25	0.28	0.47	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	448.62	496.91	526.11	503.74	417.4	288.49	194.83	203.36	305.48	401.09	422.3	429.92	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	758.56	741.69	680.03	569.2	437.81	292.5	195.66	204.66	317.42	479.97	628.4	750.83	(97)

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

(98)m=	230.59	164.49	114.52	47.13	15.19	0	0	0	0	58.69	148.39	238.76

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1017.76 | (98)

Space heating requirement in kWh/m²/year | 13.88 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1017.76	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	641.19	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	427.46	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2057.61	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1296.29	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	864.2	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	32.29	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		142.28	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	142.28	(331)
Energy for lighting (calculated in Appendix L)		322.98	(332)

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12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1395.41	x	0.22		301.41	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	414.85	x	0.52		-215.31	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2821.09	x	0.22		609.36	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	838.71	x	0.52		-435.29	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	306.59	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	16.76	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	583.51	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					583.51	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	73.85	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	167.63	(379)
Total CO2, kg/year	sum of (376)…(382) =					824.98	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					11.25	(384)
EI rating (section 14)						90.66	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 3F-7

Address : 3F-7, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.48	(1a) x	2.4	(2a) =	130.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.48	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	130.75	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows			12.15	x1/[1/(1.4)+ 0.04]		=	16.11			(27)
Walls Type1	31.32	14.25	17.07	x	0.15	=	2.56	14	238.98	(29)
Walls Type2	25.08	0	25.08	x	0.14	=	3.53	14	351.12	(29)
Walls Type3	12.6	0	12.6	x	0.13	=	1.67	14	176.4	(29)
Total area of elements, m²			69							(31)
Party wall			10.78	x	0	=	0	20	215.6	(32)
Party floor			54.48					40	2179.2	(32a)
Party ceiling			54.48					30	1634.4	(32b)
Internal wall **			57.6					9	518.4	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5314.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 97.54 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.74 (36)

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

Total fabric heat loss (33) + (36) = 32.54 (37)

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

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	10.73	10.61	10.48	9.85	9.73	9.1	9.1	8.98	9.35	9.73	9.98	10.23		(38)

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

(39)m=	43.27	43.15	43.02	42.4	42.27	41.64	41.64	41.52	41.9	42.27	42.52	42.77		

Average = Sum(39)$_{1...12}$ /12= 42.37 (39)

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

(40)m=	0.79	0.79	0.79	0.78	0.78	0.76	0.76	0.76	0.77	0.78	0.78	0.79		

Average = Sum(40)$_{1...12}$ /12= 0.78 (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 1.82 (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 77.48 (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=	85.22	82.12	79.02	75.93	72.83	69.73	69.73	72.83	75.93	79.02	82.12	85.22	

Total = Sum(44)$_{1...12}$ = 929.7 (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=	126.38	110.54	114.06	99.44	95.42	82.34	76.3	87.55	88.6	103.25	112.71	122.39	

Total = Sum(45)$_{1...12}$ = 1218.98 (45)

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

(46)m=	18.96	16.58	17.11	14.92	14.31	12.35	11.44	13.13	13.29	15.49	16.91	18.36	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	181.66	160.46	169.34	152.94	150.69	135.83	131.57	142.83	142.09	158.53	166.2	177.67	(62)

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

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

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

Output from water heater

(64)m=	181.66	160.46	169.34	152.94	150.69	135.83	131.57	142.83	142.09	158.53	166.2	177.67	

Output from water heater (annual)$_{1...12}$	1869.82	(64)

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

(65)m=	86.24	76.69	82.15	75.86	75.95	70.17	69.59	73.33	72.25	78.55	80.27	84.92	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.16	12.58	10.23	7.74	5.79	4.89	5.28	6.86	9.21	11.7	13.65	14.55	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	158.84	160.49	156.34	147.5	136.33	125.84	118.83	117.19	121.34	130.18	141.34	151.84	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	(71)
Water heating gains (Table 5)													
(72)m=	115.92	114.13	110.41	105.36	102.08	97.46	93.54	98.57	100.35	105.58	111.49	114.14	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	339.26	337.53	327.31	310.93	294.53	278.52	267.98	272.95	281.24	297.79	316.82	330.86	(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)	
West	0.9x	0.77	x	12.15	x	19.64	x	0.56	x	0.7	=	64.59	(80)
West	0.9x	0.77	x	12.15	x	38.42	x	0.56	x	0.7	=	126.36	(80)

West	0.9x	0.77	x	12.15	x	63.27	x	0.56	x	0.7	=	208.09	(80)
West	0.9x	0.77	x	12.15	x	92.28	x	0.56	x	0.7	=	303.49	(80)
West	0.9x	0.77	x	12.15	x	113.09	x	0.56	x	0.7	=	371.94	(80)
West	0.9x	0.77	x	12.15	x	115.77	x	0.56	x	0.7	=	380.75	(80)
West	0.9x	0.77	x	12.15	x	110.22	x	0.56	x	0.7	=	362.49	(80)
West	0.9x	0.77	x	12.15	x	94.68	x	0.56	x	0.7	=	311.37	(80)
West	0.9x	0.77	x	12.15	x	73.59	x	0.56	x	0.7	=	242.02	(80)
West	0.9x	0.77	x	12.15	x	45.59	x	0.56	x	0.7	=	149.94	(80)
West	0.9x	0.77	x	12.15	x	24.49	x	0.56	x	0.7	=	80.54	(80)
West	0.9x	0.77	x	12.15	x	16.15	x	0.56	x	0.7	=	53.12	(80)

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

(83)m=	64.59	126.36	208.09	303.49	371.94	380.75	362.49	311.37	242.02	149.94	80.54	53.12	(83)

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

(84)m=	403.85	463.89	535.41	614.43	666.48	659.27	630.47	584.32	523.26	447.73	397.36	383.98	(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	0.89	0.82	0.7	0.54	0.39	0.29	0.32	0.52	0.76	0.89	0.94	(86)

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

(87)m=	19.68	19.93	20.3	20.67	20.88	20.97	20.99	20.99	20.93	20.62	20.1	19.63	(87)

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

(88)m=	20.26	20.26	20.26	20.27	20.27	20.28	20.28	20.29	20.28	20.27	20.27	20.27	(88)

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

(89)m=	0.92	0.88	0.8	0.67	0.51	0.35	0.24	0.27	0.47	0.73	0.88	0.93	(89)

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

(90)m=	18.48	18.84	19.36	19.87	20.14	20.26	20.28	20.28	20.21	19.82	19.09	18.42	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.02	19.34	19.78	20.23	20.48	20.58	20.6	20.6	20.53	20.18	19.54	18.97	(92)

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

(93)m=	19.02	19.34	19.78	20.23	20.48	20.58	20.6	20.6	20.53	20.18	19.54	18.97	(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	0.86	0.79	0.67	0.52	0.37	0.26	0.29	0.49	0.73	0.86	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	365.09	401.07	423.58	409.75	345.57	243.05	165.22	172.25	254.47	326.43	343.37	350.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	637.07	622.86	571.52	480.47	370.99	249	166.62	174.33	269.47	405.09	529.18	631.6	(97)

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

(98)m=	202.35	149.05	110.07	50.92	18.91	0	0	0	0	58.52	133.78	208.79

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 932.39 (98)

Space heating requirement in kWh/m²/year 17.11 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		932.39	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	587.41	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	391.6	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1869.82	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1177.99	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	785.33	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.42	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		105.68	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	105.68	(331)
Energy for lighting (calculated in Appendix L)		250.09	(332)

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12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1278.36	x	0.22		276.13	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	380.06	x	0.52		-197.25	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2563.63	x	0.22		553.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	762.17	x	0.52		-395.57	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	279.36	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	15.27	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	531.69	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					531.69	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	54.85	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	129.8	(379)
Total CO2, kg/year	sum of (376)…(382) =					716.33	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					13.15	(384)
EI rating (section 14)						90.35	(385)

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User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 3F-8

Address : 3F-8, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.7	(1a)	x	2.4	(2a)	=	160.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.7	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			160.08	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Windows Type 3			7.63	x1/[1/(1.4)+ 0.04]		=	10.12			(27)
Walls Type1	52.8	21.9	30.9	x	0.15	=	4.64	14	432.6	(29)
Walls Type2	10.39	0	10.39	x	0.14	=	1.46	14	145.46	(29)
Total area of elements, m²			63.19							(31)
Party wall			20.53	x	0	=	0	20	410.6	(32)
Party floor			66.7					40	2668	(32a)
Party ceiling			66.7					30	2001	(32b)
Internal wall **			96					9	864	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.29 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6521.66 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 97.78 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.88 (36)

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

Total fabric heat loss (33) + (36) = 41.17 (37)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.9	13.73	13.56	12.72	12.55	11.71	11.71	11.54	12.04	12.55	12.89	13.22	(38)

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

(39)m=	55.06	54.89	54.73	53.88	53.71	52.87	52.87	52.7	53.21	53.71	54.05	54.39	

Average = Sum(39)$_{1…12}$ /12= 53.84 (39)

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

(40)m=	0.83	0.82	0.82	0.81	0.81	0.79	0.79	0.79	0.8	0.81	0.81	0.82	

Average = Sum(40)$_{1…12}$ /12= 0.81 (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 2.16 (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 85.58 (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=	94.14	90.72	87.29	83.87	80.45	77.02	77.02	80.45	83.87	87.29	90.72	94.14	

Total = Sum(44)$_{1…12}$ = 1026.98 (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=	139.61	122.1	126	109.85	105.4	90.95	84.28	96.71	97.87	114.06	124.5	135.2	

Total = Sum(45)$_{1…12}$ = 1346.53 (45)

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

(46)m=	20.94	18.32	18.9	16.48	15.81	13.64	12.64	14.51	14.68	17.11	18.68	20.28	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	194.88	172.03	181.27	163.34	160.68	144.45	139.56	151.99	151.36	169.33	178	190.48	(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=	194.88	172.03	181.27	163.34	160.68	144.45	139.56	151.99	151.36	169.33	178	190.48

Output from water heater (annual)$_{1…12}$ | 1997.37 | (64)

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

(65)m=	90.64	80.54	86.12	79.32	79.27	73.04	72.24	76.38	75.34	82.15	84.19	89.18	(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=	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	(66)

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

(67)m=	16.89	15	12.2	9.24	6.9	5.83	6.3	8.19	10.99	13.95	16.29	17.36	(67)

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

(68)m=	189.48	191.44	186.49	175.94	162.62	150.11	141.75	139.78	144.74	155.29	168.6	181.12	(68)

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

(69)m=	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	(71)

Water heating gains (Table 5)

(72)m=	121.83	119.85	115.75	110.17	106.54	101.44	97.1	102.66	104.63	110.41	116.93	119.86	(72)

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

(73)m=	383.65	381.75	369.89	350.79	331.52	312.83	300.6	306.08	315.81	335.1	357.27	373.79	(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	7.63	x	36.79	x	0.56	x	0.7	=	75.99	(77)
Southeast	0.9x	0.77	x	7.63	x	62.67	x	0.56	x	0.7	=	129.44	(77)
Southeast	0.9x	0.77	x	7.63	x	85.75	x	0.56	x	0.7	=	177.11	(77)
Southeast	0.9x	0.77	x	7.63	x	106.25	x	0.56	x	0.7	=	219.44	(77)
Southeast	0.9x	0.77	x	7.63	x	119.01	x	0.56	x	0.7	=	245.8	(77)
Southeast	0.9x	0.77	x	7.63	x	118.15	x	0.56	x	0.7	=	244.02	(77)
Southeast	0.9x	0.77	x	7.63	x	113.91	x	0.56	x	0.7	=	235.26	(77)
Southeast	0.9x	0.77	x	7.63	x	104.39	x	0.56	x	0.7	=	215.6	(77)
Southeast	0.9x	0.77	x	7.63	x	92.85	x	0.56	x	0.7	=	191.77	(77)
Southeast	0.9x	0.77	x	7.63	x	69.27	x	0.56	x	0.7	=	143.06	(77)
Southeast	0.9x	0.77	x	7.63	x	44.07	x	0.56	x	0.7	=	91.02	(77)
Southeast	0.9x	0.77	x	7.63	x	31.49	x	0.56	x	0.7	=	65.03	(77)
South	0.9x	0.77	x	3.82	x	46.75	x	0.56	x	0.7	=	48.34	(78)
South	0.9x	0.77	x	3.82	x	76.57	x	0.56	x	0.7	=	79.17	(78)
South	0.9x	0.77	x	3.82	x	97.53	x	0.56	x	0.7	=	100.85	(78)
South	0.9x	0.77	x	3.82	x	110.23	x	0.56	x	0.7	=	113.98	(78)
South	0.9x	0.77	x	3.82	x	114.87	x	0.56	x	0.7	=	118.78	(78)
South	0.9x	0.77	x	3.82	x	110.55	x	0.56	x	0.7	=	114.31	(78)
South	0.9x	0.77	x	3.82	x	108.01	x	0.56	x	0.7	=	111.69	(78)
South	0.9x	0.77	x	3.82	x	104.89	x	0.56	x	0.7	=	108.46	(78)
South	0.9x	0.77	x	3.82	x	101.89	x	0.56	x	0.7	=	105.35	(78)
South	0.9x	0.77	x	3.82	x	82.59	x	0.56	x	0.7	=	85.4	(78)
South	0.9x	0.77	x	3.82	x	55.42	x	0.56	x	0.7	=	57.3	(78)
South	0.9x	0.77	x	3.82	x	40.4	x	0.56	x	0.7	=	41.77	(78)
West	0.9x	0.77	x	8.35	x	19.64	x	0.56	x	0.7	=	44.39	(80)
West	0.9x	0.77	x	8.35	x	38.42	x	0.56	x	0.7	=	86.84	(80)
West	0.9x	0.77	x	8.35	x	63.27	x	0.56	x	0.7	=	143.01	(80)
West	0.9x	0.77	x	8.35	x	92.28	x	0.56	x	0.7	=	208.57	(80)
West	0.9x	0.77	x	8.35	x	113.09	x	0.56	x	0.7	=	255.62	(80)
West	0.9x	0.77	x	8.35	x	115.77	x	0.56	x	0.7	=	261.67	(80)
West	0.9x	0.77	x	8.35	x	110.22	x	0.56	x	0.7	=	249.12	(80)
West	0.9x	0.77	x	8.35	x	94.68	x	0.56	x	0.7	=	213.99	(80)
West	0.9x	0.77	x	8.35	x	73.59	x	0.56	x	0.7	=	166.33	(80)
West	0.9x	0.77	x	8.35	x	45.59	x	0.56	x	0.7	=	103.04	(80)
West	0.9x	0.77	x	8.35	x	24.49	x	0.56	x	0.7	=	55.35	(80)
West	0.9x	0.77	x	8.35	x	16.15	x	0.56	x	0.7	=	36.51	(80)

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

(83)m=	168.73	295.45	420.97	542	620.19	620	596.07	538.05	463.45	331.5	203.67	143.31	(83)

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

(84)m=	552.37	677.2	790.86	892.8	951.71	932.83	896.67	844.14	779.26	666.6	560.95	517.1	(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

DER WorkSheet: New dwelling design stage

(86)m=	0.91	0.85	0.76	0.63	0.49	0.35	0.26	0.28	0.45	0.69	0.86	0.92	(86)

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

(87)m=	19.72	20.06	20.42	20.73	20.9	20.98	20.99	20.99	20.95	20.7	20.17	19.66	(87)

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

(88)m=	20.23	20.23	20.24	20.25	20.25	20.26	20.26	20.26	20.26	20.25	20.24	20.24	(88)

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

(89)m=	0.9	0.84	0.74	0.61	0.46	0.32	0.21	0.24	0.41	0.66	0.85	0.92	(89)

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

(90)m=	18.53	19	19.5	19.93	20.14	20.24	20.26	20.26	20.2	19.9	19.18	18.44	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.07	19.48	19.91	20.29	20.49	20.57	20.59	20.59	20.54	20.26	19.63	18.99	(92)

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

(93)m=	19.07	19.48	19.91	20.29	20.49	20.57	20.59	20.59	20.54	20.26	19.63	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.82	0.73	0.61	0.47	0.33	0.23	0.26	0.42	0.66	0.83	0.9	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	488.18	556.14	579.83	542.31	446.34	309.75	209.56	218.79	329.19	441.15	465.65	464.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	813.3	800.32	734.08	613.88	472.03	315.76	210.96	220.77	342.68	519.01	677.18	804.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	241.89	164.09	114.76	51.53	19.12	0	0	0	0	57.92	152.3	253.04	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1054.66 (98)

Space heating requirement in kWh/m²/year 15.81 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP 0.6 (303a)

Fraction of community heat from heat source 2 0.4 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.6 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.4 (304b)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

DER WorkSheet: New dwelling design stage

Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1054.66	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	664.43	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	442.96	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1997.37	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1258.34	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	838.89	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	32.05	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		129.38	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	129.38	(331)
Energy for lighting (calculated in Appendix L)		298.32	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1445.99	x	0.22		312.33	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	429.89	x	0.52		-223.12	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2738.5	x	0.22		591.52	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	814.16	x	0.52		-422.55	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	304.26	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	16.63	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	579.08	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					579.08	(376)

DER WorkSheet: New dwelling design stage

CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	67.15	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	154.83	(379)
Total CO2, kg/year	sum of (376)…(382) =			801.06	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			12.01	(384)
EI rating (section 14)				90.39	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 4F-10

Address : 4F-10, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	86.56	(1a) x	2.4	(2a) =	207.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.56	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	207.74	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.22	x1/[1/(1.4)+ 0.04]		=	20.18			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Walls Type1	52.25	25.67	26.58	x	0.15	=	3.99	14	372.12	(29)
Walls Type2	17.09	0	17.09	x	0.14	=	2.41	14	239.26	(29)
Roof	86.56	0	86.56	x	0.11	=	9.52	9	779.04	(30)
Total area of elements, m²			155.9							(31)
Party wall			32.95	x	0	=	0	20	659	(32)
Party floor			86.56					40	3462.4	(32a)
Internal wall **			163.2					9	1468.8	(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 50.1 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6980.62 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 80.64 (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 12.37 (36)

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

Total fabric heat loss (33) + (36) = 62.47 (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

DER WorkSheet: New dwelling design stage

(38)m=	18.03	17.82	17.6	16.5	16.29	15.19	15.19	14.98	15.63	16.29	16.72	17.16	(38)

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

(39)m=	80.51	80.29	80.07	78.98	78.76	77.67	77.67	77.45	78.11	78.76	79.2	79.64	

Average = Sum(39)$_{1…12}$ /12= 78.92 (39)

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

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.91	0.92	

Average = Sum(40)$_{1…12}$ /12= 0.91 (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 2.58 (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 95.37 (43)

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

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=	104.91	101.09	97.28	93.46	89.65	85.83	85.83	89.65	93.46	97.28	101.09	104.91	

Total = Sum(44)$_{1…12}$ = 1144.46 (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=	155.58	136.07	140.41	122.41	117.46	101.36	93.92	107.78	109.06	127.1	138.74	150.67	

Total = Sum(45)$_{1…12}$ = 1500.57 (45)

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

(46)m=	23.34	20.41	21.06	18.36	17.62	15.2	14.09	16.17	16.36	19.07	20.81	22.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94	(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=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94

Output from water heater (annual)$_{1\ldots12}$ | 2151.41 | (64)

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

(65)m=	95.95	85.18	90.91	83.5	83.28	76.5	75.45	80.06	79.06	86.48	88.93	94.32	(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=	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	(66)

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

(67)m=	20.74	18.42	14.98	11.34	8.48	7.16	7.73	10.05	13.49	17.13	19.99	21.31	(67)

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

(68)m=	232.6	235.02	228.94	215.99	199.64	184.28	174.02	171.6	177.68	190.63	206.98	222.34	(68)

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

(69)m=	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	(71)

Water heating gains (Table 5)

(72)m=	128.97	126.76	122.19	115.97	111.93	106.24	101.41	107.6	109.8	116.24	123.51	126.77	(72)

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

(73)m=	443.94	441.83	427.74	404.93	381.68	359.32	344.8	350.89	362.61	385.64	412.12	432.06	(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)	
North	0.9x	0.77	x	8.35	x	10.63	x	0.558	x	0.7	=	24.03	(74)
North	0.9x	0.77	x	8.35	x	20.32	x	0.558	x	0.7	=	45.93	(74)

North	0.9x	0.77	x	8.35	x	34.53	x	0.558	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	8.35	x	55.46	x	0.558	x	0.7	=	125.36	(74)
North	0.9x	0.77	x	8.35	x	74.72	x	0.558	x	0.7	=	168.87	(74)
North	0.9x	0.77	x	8.35	x	79.99	x	0.558	x	0.7	=	180.79	(74)
North	0.9x	0.77	x	8.35	x	74.68	x	0.558	x	0.7	=	168.79	(74)
North	0.9x	0.77	x	8.35	x	59.25	x	0.558	x	0.7	=	133.91	(74)
North	0.9x	0.77	x	8.35	x	41.52	x	0.558	x	0.7	=	93.84	(74)
North	0.9x	0.77	x	8.35	x	24.19	x	0.558	x	0.7	=	54.67	(74)
North	0.9x	0.77	x	8.35	x	13.12	x	0.558	x	0.7	=	29.65	(74)
North	0.9x	0.77	x	8.35	x	8.86	x	0.558	x	0.7	=	20.04	(74)
East	0.9x	1	x	15.22	x	19.64	x	0.56	x	0.7	=	80.91	(76)
East	0.9x	1	x	15.22	x	38.42	x	0.56	x	0.7	=	158.29	(76)
East	0.9x	1	x	15.22	x	63.27	x	0.56	x	0.7	=	260.68	(76)
East	0.9x	1	x	15.22	x	92.28	x	0.56	x	0.7	=	380.18	(76)
East	0.9x	1	x	15.22	x	113.09	x	0.56	x	0.7	=	465.92	(76)
East	0.9x	1	x	15.22	x	115.77	x	0.56	x	0.7	=	476.96	(76)
East	0.9x	1	x	15.22	x	110.22	x	0.56	x	0.7	=	454.08	(76)
East	0.9x	1	x	15.22	x	94.68	x	0.56	x	0.7	=	390.05	(76)
East	0.9x	1	x	15.22	x	73.59	x	0.56	x	0.7	=	303.18	(76)
East	0.9x	1	x	15.22	x	45.59	x	0.56	x	0.7	=	187.82	(76)
East	0.9x	1	x	15.22	x	24.49	x	0.56	x	0.7	=	100.89	(76)
East	0.9x	1	x	15.22	x	16.15	x	0.56	x	0.7	=	66.54	(76)

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

(83)m=	104.95	204.22	338.72	505.54	634.8	657.74	622.87	523.96	397.01	242.49	130.54	86.58	(83)

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

(84)m=	548.89	646.05	766.46	910.47	1016.48	1017.06	967.66	874.85	759.63	628.13	542.66	518.64	(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=	0.94	0.91	0.85	0.74	0.6	0.45	0.34	0.38	0.59	0.81	0.91	0.95	(86)

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

(87)m=	18.88	19.2	19.7	20.28	20.68	20.89	20.96	20.95	20.77	20.21	19.44	18.83	(87)

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

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)

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

(89)m=	0.93	0.9	0.84	0.72	0.56	0.4	0.28	0.32	0.54	0.79	0.9	0.94	(89)

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

(90)m=	17.29	17.74	18.45	19.26	19.8	20.07	20.14	20.13	19.93	19.18	18.11	17.21	(90)

fLA = Living area ÷ (4) = 0.28 (91)

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

(92)m=	17.73	18.14	18.8	19.55	20.04	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(92)

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

(93)m=	17.73	18.14	18.8	19.55	20.04	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(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	0.87	0.81	0.7	0.56	0.41	0.29	0.34	0.54	0.76	0.88	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	498.31	563.31	618.37	633.32	564.9	414	284.33	294.23	411.81	479.05	475.16	475.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1081.22	1063.43	984.82	840.83	657.14	442.6	292.9	306.62	473.72	698.45	901.19	1071.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	433.69	336.08	272.64	149.41	68.63	0	0	0	0	163.24	306.74	443.57	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2173.98 (98)

Space heating requirement in kWh/m²/year 25.12 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2173.98	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1369.61	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	913.07	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2151.41	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1355.39	(310a)

DER WorkSheet: New dwelling design stage

Water heat from heat source 2	(64) x (303b) x (305) x (306) =	903.59	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	45.42	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		167.91	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	167.91	(331)
Energy for lighting (calculated in Appendix L)		366.22	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2980.64	x	0.22		643.82	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	886.15	x	0.52		-459.91	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2949.7	x	0.22		637.13	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	876.95	x	0.52		-455.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	431.21	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	23.57	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	820.69	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					820.69	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	87.14	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	190.07	(379)
Total CO2, kg/year	sum of (376)…(382) =					1097.9	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					12.68	(384)
EI rating (section 14)						88.82	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 4F-9

Address : 4F-9, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	86.56	(1a)	x	2.4	(2a)	=	207.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.56	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			207.74	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

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

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

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

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

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

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

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.22	x1/[1/(1.4)+ 0.04]		=	20.18			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Walls Type1	51.14	25.67	25.47	x	0.15	=	3.82	14	356.58	(29)
Walls Type2	8.21	0	8.21	x	0.14	=	1.16	14	114.94	(29)
Walls Type3	9.98	0	9.98	x	0.13	=	1.32	14	139.72	(29)
Roof	86.56	0	86.56	x	0.11	=	9.52	9	779.04	(30)
Total area of elements, m²			155.89							(31)
Party wall			32.95	x	0	=	0	20	659	(32)
Party floor			86.56					40	3462.4	(32a)
Internal wall **			163.2					9	1468.8	(32c)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	50.01	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6980.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	80.64	(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 12.37 (36)

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

Total fabric heat loss (33) + (36) = 62.38 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.03	17.82	17.6	16.5	16.29	15.19	15.19	14.98	15.63	16.29	16.72	17.16	(38)

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

(39)m=	80.41	80.19	79.97	78.88	78.66	77.57	77.57	77.35	78.01	78.66	79.1	79.54	

Average = Sum(39)$_{1...12}$ /12= 78.83 (39)

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

(40)m=	0.93	0.93	0.92	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.91	0.92	

Average = Sum(40)$_{1...12}$ /12= 0.91 (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 2.58 (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 95.37 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	104.91	101.09	97.28	93.46	89.65	85.83	85.83	89.65	93.46	97.28	101.09	104.91	

Total = Sum(44)$_{1...12}$ = 1144.46 (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=	155.58	136.07	140.41	122.41	117.46	101.36	93.92	107.78	109.06	127.1	138.74	150.67	

Total = Sum(45)$_{1...12}$ = 1500.57 (45)

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

(46)m=	23.34	20.41	21.06	18.36	17.62	15.2	14.09	16.17	16.36	19.07	20.81	22.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94	(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=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94

Output from water heater (annual)$_{1...12}$ | 2151.41 | (64)

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

(65)m=	95.95	85.18	90.91	83.5	83.28	76.5	75.45	80.06	79.06	86.48	88.93	94.32	(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=	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	(66)

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

(67)m=	20.74	18.42	14.98	11.34	8.48	7.16	7.73	10.05	13.49	17.13	19.99	21.31	(67)

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

(68)m=	232.6	235.02	228.94	215.99	199.64	184.28	174.02	171.6	177.68	190.63	206.98	222.34	(68)

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

(69)m=	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	(71)

Water heating gains (Table 5)

(72)m=	128.97	126.76	122.19	115.97	111.93	106.24	101.41	107.6	109.8	116.24	123.51	126.77	(72)

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

(73)m=	443.94	441.83	427.74	404.93	381.68	359.32	344.8	350.89	362.61	385.64	412.12	432.06	(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)

North	0.9x	0.77	x	8.35	x	10.63	x	0.558	x	0.7	=	24.03	(74)
North	0.9x	0.77	x	8.35	x	20.32	x	0.558	x	0.7	=	45.93	(74)
North	0.9x	0.77	x	8.35	x	34.53	x	0.558	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	8.35	x	55.46	x	0.558	x	0.7	=	125.36	(74)
North	0.9x	0.77	x	8.35	x	74.72	x	0.558	x	0.7	=	168.87	(74)
North	0.9x	0.77	x	8.35	x	79.99	x	0.558	x	0.7	=	180.79	(74)
North	0.9x	0.77	x	8.35	x	74.68	x	0.558	x	0.7	=	168.79	(74)
North	0.9x	0.77	x	8.35	x	59.25	x	0.558	x	0.7	=	133.91	(74)
North	0.9x	0.77	x	8.35	x	41.52	x	0.558	x	0.7	=	93.84	(74)
North	0.9x	0.77	x	8.35	x	24.19	x	0.558	x	0.7	=	54.67	(74)
North	0.9x	0.77	x	8.35	x	13.12	x	0.558	x	0.7	=	29.65	(74)
North	0.9x	0.77	x	8.35	x	8.86	x	0.558	x	0.7	=	20.04	(74)
West	0.9x	0.77	x	15.22	x	19.64	x	0.56	x	0.7	=	80.91	(80)
West	0.9x	0.77	x	15.22	x	38.42	x	0.56	x	0.7	=	158.29	(80)
West	0.9x	0.77	x	15.22	x	63.27	x	0.56	x	0.7	=	260.68	(80)
West	0.9x	0.77	x	15.22	x	92.28	x	0.56	x	0.7	=	380.18	(80)
West	0.9x	0.77	x	15.22	x	113.09	x	0.56	x	0.7	=	465.92	(80)
West	0.9x	0.77	x	15.22	x	115.77	x	0.56	x	0.7	=	476.96	(80)
West	0.9x	0.77	x	15.22	x	110.22	x	0.56	x	0.7	=	454.08	(80)
West	0.9x	0.77	x	15.22	x	94.68	x	0.56	x	0.7	=	390.05	(80)
West	0.9x	0.77	x	15.22	x	73.59	x	0.56	x	0.7	=	303.18	(80)
West	0.9x	0.77	x	15.22	x	45.59	x	0.56	x	0.7	=	187.82	(80)
West	0.9x	0.77	x	15.22	x	24.49	x	0.56	x	0.7	=	100.89	(80)
West	0.9x	0.77	x	15.22	x	16.15	x	0.56	x	0.7	=	66.54	(80)

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

(83)m=	104.95	204.22	338.72	505.54	634.8	657.74	622.87	523.96	397.01	242.49	130.54	86.58	(83)

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

(84)m=	548.89	646.05	766.46	910.47	1016.48	1017.06	967.66	874.85	759.63	628.13	542.66	518.64	(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=	0.94	0.91	0.85	0.74	0.6	0.45	0.34	0.38	0.59	0.81	0.91	0.95	(86)

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

(87)m=	18.89	19.2	19.7	20.28	20.68	20.9	20.96	20.95	20.77	20.21	19.45	18.83	(87)

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

(88)m=	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.16	20.15	(88)

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

(89)m=	0.93	0.9	0.84	0.72	0.56	0.4	0.28	0.32	0.54	0.79	0.9	0.94	(89)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(90)m=	17.29	17.74	18.46	19.27	19.8	20.07	20.14	20.13	19.93	19.19	18.11	17.21		(90)

fLA = Living area ÷ (4) = 0.28 (91)

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

(92)m=	17.73	18.15	18.8	19.55	20.05	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(92)

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

(93)m=	17.73	18.15	18.8	19.55	20.05	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(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	0.87	0.81	0.7	0.56	0.41	0.29	0.34	0.54	0.76	0.88	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	498.3	563.28	618.28	633.13	564.59	413.68	284.08	293.98	411.58	478.95	475.13	475.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1080.25	1062.47	983.92	840.02	656.47	442.13	292.59	306.3	473.24	697.8	900.37	1070.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	432.98	335.46	272.03	148.97	68.36	0	0	0	0	162.83	306.17	442.85	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2169.64 (98)

Space heating requirement in kWh/m²/year 25.07 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2169.64	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1366.88	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	911.25	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2151.41	

If DHW from community scheme:

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Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1355.39	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	903.59	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	45.37	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		167.91	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	167.91	(331)
Energy for lighting (calculated in Appendix L)		366.22	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2974.7	x	0.22		642.54	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	884.38	x	0.52		-458.99	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2949.7	x	0.22		637.13	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	876.95	x	0.52		-455.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	430.78	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	23.55	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	819.87	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					819.87	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	87.14	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	190.07	(379)
Total CO2, kg/year	sum of (376)…(382) =					1097.08	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					12.67	(384)
EI rating (section 14)						88.83	(385)

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User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 GF-1

Address : GF-1, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	73.52	(1a)	x	2.4	(2a)	=	176.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.52	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			176.45	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.8	x1/[1/(1.4)+ 0.04]		=	5.04			(27)
Windows Type 2			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Floor			73.52	x	0.11	=	8.087199	110	8087.2	(28)
Walls Type1	47.64	21.86	25.78	x	0.15	=	3.87	14	360.92	(29)
Walls Type2	2.4	0	2.4	x	0.14	=	0.34	14	33.6	(29)
Total area of elements, m²			123.56							(31)
Party wall			37.13	x	0	=	0	20	742.6	(32)
Party ceiling			73.52					30	2205.6	(32b)
Internal wall **			110.4					9	993.6	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.43 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12423.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 168.98 (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 9.46 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 50.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.48	14.31	14.14	13.3	13.13	12.28	12.28	12.11	12.62	13.13	13.47	13.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	65.37	65.2	65.03	64.19	64.02	63.17	63.17	63	63.51	64.02	64.36	64.7

Average = Sum(39)$_{1...12}$ /12= 64.15 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.87	0.88	0.88

Average = Sum(40)$_{1...12}$ /12= 0.87 (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 2.33 (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 89.5 (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=	98.45	94.87	91.29	87.71	84.13	80.55	80.55	84.13	87.71	91.29	94.87	98.45

Total = Sum(44)$_{1...12}$ = 1074.01 (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=	146	127.69	131.77	114.88	110.23	95.12	88.14	101.14	102.35	119.28	130.2	141.39

Total = Sum(45)$_{1...12}$ = 1408.2 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.9	19.15	19.77	17.23	16.53	14.27	13.22	15.17	15.35	17.89	19.53	21.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.28	177.62	187.04	168.37	165.5	148.61	143.42	156.42	155.85	174.56	183.7	196.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.28	177.62	187.04	168.37	165.5	148.61	143.42	156.42	155.85	174.56	183.7	196.67	

Output from water heater (annual)$_{1...12}$	2059.04	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.77	82.4	88.03	80.99	80.87	74.42	73.53	77.85	76.83	83.88	86.09	91.23	(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=	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.31	16.26	13.22	10.01	7.48	6.32	6.83	8.87	11.91	15.12	17.65	18.82	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	205.37	207.5	202.13	190.7	176.27	162.7	153.64	151.51	156.88	168.31	182.74	196.31	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	(71)

Water heating gains (Table 5)

(72)m=	124.69	122.62	118.33	112.49	108.7	103.36	98.83	104.64	106.7	112.74	119.57	122.63	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	406.29	404.31	391.61	371.13	350.38	330.31	317.22	322.95	333.42	354.11	377.89	395.68	(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)	
North	0.9x	0.77	x	3.8	x	10.63	x	0.48	x	0.7	=	9.41	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.48	x	0.7	=	17.98	(74)

North	0.9x	0.77	x	3.8	x	34.53	x	0.48	x	0.7	=	30.55	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.48	x	0.7	=	49.08	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.48	x	0.7	=	66.11	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.48	x	0.7	=	70.77	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.48	x	0.7	=	66.08	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.48	x	0.7	=	52.42	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.48	x	0.7	=	36.73	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.48	x	0.7	=	21.4	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.48	x	0.7	=	11.61	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.48	x	0.7	=	7.84	(74)
East	0.9x	1	x	15.96	x	19.64	x	0.48	x	0.7	=	72.99	(76)
East	0.9x	1	x	15.96	x	38.42	x	0.48	x	0.7	=	142.78	(76)
East	0.9x	1	x	15.96	x	63.27	x	0.48	x	0.7	=	235.14	(76)
East	0.9x	1	x	15.96	x	92.28	x	0.48	x	0.7	=	342.94	(76)
East	0.9x	1	x	15.96	x	113.09	x	0.48	x	0.7	=	420.28	(76)
East	0.9x	1	x	15.96	x	115.77	x	0.48	x	0.7	=	430.23	(76)
East	0.9x	1	x	15.96	x	110.22	x	0.48	x	0.7	=	409.6	(76)
East	0.9x	1	x	15.96	x	94.68	x	0.48	x	0.7	=	351.84	(76)
East	0.9x	1	x	15.96	x	73.59	x	0.48	x	0.7	=	273.48	(76)
East	0.9x	1	x	15.96	x	45.59	x	0.48	x	0.7	=	169.42	(76)
East	0.9x	1	x	15.96	x	24.49	x	0.48	x	0.7	=	91.01	(76)
East	0.9x	1	x	15.96	x	16.15	x	0.48	x	0.7	=	60.02	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	82.4	160.76	265.69	392.01	486.39	501.01	475.67	404.26	310.21	190.82	102.61	67.87	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	488.69	565.07	657.3	763.14	836.77	831.32	792.9	727.21	643.63	544.93	480.5	463.55	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.93	0.83	0.66	0.48	0.35	0.4	0.64	0.89	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.88	20.08	20.39	20.73	20.92	20.99	21	21	20.95	20.67	20.21	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.18	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.92	0.8	0.62	0.42	0.29	0.33	0.58	0.87	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.68	18.97	19.41	19.88	20.11	20.19	20.2	20.2	20.16	19.81	19.17	18.63	(90)

fLA = Living area ÷ (4) = | 0.36 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(92)m=	19.11	19.37	19.76	20.19	20.4	20.48	20.49	20.49	20.44	20.12	19.54	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.11	19.37	19.76	20.19	20.4	20.48	20.49	20.49	20.44	20.12	19.54	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.91	0.8	0.63	0.44	0.31	0.35	0.6	0.86	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	477.41	541.42	598.73	609.7	525.19	366.34	244.81	256.15	384.15	470.74	460.79	454.76	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	968.13	943.27	862.61	724.47	557.25	371.27	245.55	257.48	402.74	609.34	800.81	961.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	365.09	270.04	196.33	82.63	23.85	0	0	0	0	103.12	244.82	377.19	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1663.08 (98)

Space heating requirement in kWh/m²/year 22.62 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1663.08	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1047.74	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	698.49	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2059.04	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1297.19	(310a)

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Water heat from heat source 2	(64) x (303b) x (305) x (306) =	864.8	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	39.08	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		142.61	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	142.61	(331)
Energy for lighting (calculated in Appendix L)		323.34	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2280.17	x	0.22		492.52	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	677.9	x	0.52		-351.83	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2823.06	x	0.22		609.78	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	839.29	x	0.52		-435.59	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	371.07	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	20.28	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	706.23	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					706.23	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	74.02	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	167.81	(379)
Total CO2, kg/year	sum of (376)…(382) =					948.06	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					12.9	(384)
EI rating (section 14)						89.28	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 GF-2

Address : GF-2, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	90.93	(1a) x	2.4	(2a) =	218.23	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.93	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	218.23	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			12.15	x1/[1/(1.4)+ 0.04]		=	16.11			(27)
Windows Type 2			7.63	x1/[1/(1.4)+ 0.04]		=	10.12			(27)
Floor			90.93	x	0.11	=	10.0023	110	10002.3	(28)
Walls Type1	77.99	21.88	56.11	x	0.15	=	8.42	14	785.54	(29)
Walls Type2	3.6	0	3.6	x	0.14	=	0.51	14	50.4	(29)
Walls Type3	4.8	0	4.8	x	0.15	=	0.72	14	67.2	(29)
Total area of elements, m²			177.32							(31)
Party wall			22.8	x	0	=	0	20	456	(32)
Party ceiling			90.93					30	2727.9	(32b)
Internal wall **			153.6					9	1382.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15471.74 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 170.15 (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 12.2 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 61.01 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.94	18.72	18.49	17.34	17.11	15.96	15.96	15.73	16.42	17.11	17.57	18.03	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.96	79.73	79.5	78.35	78.12	76.97	76.97	76.74	77.43	78.12	78.58	79.04	

Average = Sum(39)$_{1…12}$ /12= 78.29 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.88	0.88	0.87	0.86	0.86	0.85	0.85	0.84	0.85	0.86	0.86	0.87	

Average = Sum(40)$_{1…12}$ /12= 0.86 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.64 (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 96.86 (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=	106.54	102.67	98.8	94.92	91.05	87.17	87.17	91.05	94.92	98.8	102.67	106.54	

Total = Sum(44)$_{1…12}$ = 1162.3 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	158	138.19	142.6	124.32	119.29	102.94	95.39	109.46	110.76	129.09	140.91	153.02	

Total = Sum(45)$_{1…12}$ = 1523.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.7	20.73	21.39	18.65	17.89	15.44	14.31	16.42	16.61	19.36	21.14	22.95	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	213.28	188.12	197.88	177.81	174.57	156.43	150.66	164.73	164.26	184.36	194.4	208.29	(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=	213.28	188.12	197.88	177.81	174.57	156.43	150.66	164.73	164.26	184.36	194.4	208.29

Output from water heater (annual)$_{1...12}$ — 2174.8 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	96.76	85.89	91.64	84.13	83.89	77.02	75.94	80.62	79.62	87.14	89.65	95.1	(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=	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.48	19.08	15.52	11.75	8.78	7.41	8.01	10.41	13.98	17.75	20.71	22.08	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	240.78	243.28	236.98	223.58	206.66	190.75	180.13	177.63	183.93	197.33	214.25	230.15	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	(71)

Water heating gains (Table 5)

(72)m=	130.05	127.81	123.17	116.85	112.75	106.97	102.07	108.35	110.59	117.13	124.51	127.82	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	454.88	452.74	438.24	414.75	390.76	367.72	352.78	358.97	371.07	394.78	422.05	442.63	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.77	x	7.63	x	36.79	x	0.44	x	0.7	=	59.92	(77)
Southeast	0.9x	0.77	x	7.63	x	62.67	x	0.44	x	0.7	=	102.07	(77)
Southeast	0.9x	0.77	x	7.63	x	85.75	x	0.44	x	0.7	=	139.65	(77)
Southeast	0.9x	0.77	x	7.63	x	106.25	x	0.44	x	0.7	=	173.04	(77)
Southeast	0.9x	0.77	x	7.63	x	119.01	x	0.44	x	0.7	=	193.82	(77)
Southeast	0.9x	0.77	x	7.63	x	118.15	x	0.44	x	0.7	=	192.42	(77)
Southeast	0.9x	0.77	x	7.63	x	113.91	x	0.44	x	0.7	=	185.51	(77)
Southeast	0.9x	0.77	x	7.63	x	104.39	x	0.44	x	0.7	=	170.01	(77)
Southeast	0.9x	0.77	x	7.63	x	92.85	x	0.44	x	0.7	=	151.22	(77)
Southeast	0.9x	0.77	x	7.63	x	69.27	x	0.44	x	0.7	=	112.81	(77)
Southeast	0.9x	0.77	x	7.63	x	44.07	x	0.44	x	0.7	=	71.77	(77)
Southeast	0.9x	0.77	x	7.63	x	31.49	x	0.44	x	0.7	=	51.28	(77)
South	0.9x	0.77	x	12.15	x	46.75	x	0.44	x	0.7	=	121.24	(78)
South	0.9x	0.77	x	12.15	x	76.57	x	0.44	x	0.7	=	198.57	(78)
South	0.9x	0.77	x	12.15	x	97.53	x	0.44	x	0.7	=	252.94	(78)
South	0.9x	0.77	x	12.15	x	110.23	x	0.44	x	0.7	=	285.88	(78)
South	0.9x	0.77	x	12.15	x	114.87	x	0.44	x	0.7	=	297.9	(78)
South	0.9x	0.77	x	12.15	x	110.55	x	0.44	x	0.7	=	286.69	(78)
South	0.9x	0.77	x	12.15	x	108.01	x	0.44	x	0.7	=	280.11	(78)
South	0.9x	0.77	x	12.15	x	104.89	x	0.44	x	0.7	=	272.03	(78)
South	0.9x	0.77	x	12.15	x	101.89	x	0.44	x	0.7	=	264.22	(78)
South	0.9x	0.77	x	12.15	x	82.59	x	0.44	x	0.7	=	214.17	(78)
South	0.9x	0.77	x	12.15	x	55.42	x	0.44	x	0.7	=	143.72	(78)
South	0.9x	0.77	x	12.15	x	40.4	x	0.44	x	0.7	=	104.77	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	181.17	300.64	392.59	458.91	491.72	479.11	465.62	442.04	415.44	326.98	215.49	156.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	636.05	753.38	830.83	873.66	882.48	846.82	818.4	801.01	786.51	721.76	637.53	598.68	(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=	0.98	0.96	0.93	0.86	0.74	0.56	0.41	0.44	0.64	0.87	0.96	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.95	20.17	20.43	20.7	20.88	20.98	21	20.99	20.95	20.72	20.29	19.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.2	20.2	20.21	20.21	20.22	20.21	20.2	20.2	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.91	0.83	0.69	0.5	0.34	0.36	0.58	0.84	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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(90)m=	18.78	19.1	19.47	19.85	20.08	20.19	20.21	20.21	20.17	19.89	19.28	18.73	(90)

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.18	19.47	19.8	20.14	20.36	20.46	20.48	20.48	20.44	20.18	19.63	19.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.18	19.47	19.8	20.14	20.36	20.46	20.48	20.48	20.44	20.18	19.63	19.13	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.95	0.9	0.83	0.7	0.52	0.36	0.39	0.6	0.84	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	618.76	713.65	751.74	722.16	617.84	440.19	297.12	310.97	469.28	604.82	604.91	585.61	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1190.1	1161.88	1057.64	880.88	676.51	451.29	298.75	313.22	490.87	748.08	984.74	1180.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	425.07	301.21	227.59	114.28	43.66	0	0	0	0	106.59	273.47	442.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1934.31 (98)

Space heating requirement in kWh/m²/year 21.27 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1934.31	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1218.61	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	812.41	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement 2174.8

If DHW from community scheme:

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Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1370.12	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	913.41	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	43.15	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		176.39	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	176.39	(331)
Energy for lighting (calculated in Appendix L)		379.38	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2652.04	x	0.22		572.84	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	788.45	x	0.52		-409.21	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2981.77	x	0.22		644.06	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	886.48	x	0.52		-460.08	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	409.65	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	22.39	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	779.65	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					779.65	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	91.54	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	196.9	(379)
Total CO2, kg/year	sum of (376)…(382) =					1068.09	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					11.75	(384)
EI rating (section 14)						89.47	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 House-11

Address : House-11, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	67.15	(1a)	x	2.4	(2a)	=	161.16	(3a)
First floor	61.15	(1b)	x	2.47	(2b)	=	151.04	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	128.3	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	312.2	(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) =	0.13	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.28	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.26	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.33	0.32	0.32	0.28	0.28	0.24	0.24	0.24	0.26	0.28	0.29	0.3

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=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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			2.1	x	1.4	=	2.94			(26)
Windows Type 1			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 2			11.61	x1/[1/(1.4)+ 0.04]		=	15.39			(27)
Rooflights Type 1			4.05	x1/[1/(1.4) + 0.04]		=	5.67			(27b)
Rooflights Type 2			5.4	x1/[1/(1.4) + 0.04]		=	7.56			(27b)
Floor			67.15	x	0.13	=	8.7295	110	7386.5	(28)
Walls	104.64	16.59	88.05	x	0.15	=	13.21	150	13207.5	(29)
Roof Type1	40.31	0	40.31	x	0.11	=	4.43	9	362.79	(30)
Roof Type2	30.99	9.45	21.54	x	0.11	=	2.37	9	193.86	(30)
Total area of elements, m²			243.09							(31)
Party wall			39.55	x	0	=	0	70	2768.5	(32)
Internal wall **			216					9	1944	(32c)
Internal floor			61.15					18	1100.7	(32d)
Internal ceiling			61.15					9	550.35	(32e)

** 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) = 63.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27514.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 214.45 (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		19.78	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	83.19	(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=	57.06	56.84	56.63	55.64	55.45	54.59	54.59	54.43	54.92	55.45	55.83	56.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	140.25	140.03	139.82	138.83	138.65	137.78	137.78	137.62	138.12	138.65	139.02	139.41

Average = $Sum(39)_{1...12}$ /12= 138.83 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.09	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.08	1.08	1.08	1.09

Average = $Sum(40)_{1...12}$ /12= 1.08 (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 2.89 (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) + 36 102.85 (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=	113.13	109.02	104.91	100.79	96.68	92.56	92.56	96.68	100.79	104.91	109.02	113.13

Total = $Sum(44)_{1...12}$ = 1234.18 (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=	167.77	146.74	151.42	132.01	126.67	109.3	101.29	116.23	117.61	137.07	149.62	162.48

Total = $Sum(45)_{1...12}$ = 1618.2 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.17	22.01	22.71	19.8	19	16.4	15.19	17.43	17.64	20.56	22.44	24.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.96	49.32	49.27	45.65	47.17	49.27	49.32	50.96	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=	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44	(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=	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44

Output from water heater (annual)$_{1...12}$ — 2207.36 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	68.52	60.3	63.09	56.22	54.43	47.76	45.47	50.96	51.44	58.32	62.08	66.76	(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=	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	26.52	23.56	19.16	14.5	10.84	9.15	9.89	12.86	17.25	21.91	25.57	27.26	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	295.66	298.73	291	274.54	253.76	234.23	221.19	218.12	225.85	242.31	263.09	282.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	(71)
Water heating gains (Table 5)													
(72)m=	92.1	89.73	84.79	78.09	73.16	66.33	61.12	68.5	71.44	78.38	86.22	89.74	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	483.64	481.37	464.3	436.48	407.12	379.07	361.55	368.83	383.9	411.96	444.23	468.97	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	2.88	x	19.64	x	0.76	x	0.7	=	20.85	(76)
East	0.9x	1	x	2.88	x	38.42	x	0.76	x	0.7	=	40.79	(76)
East	0.9x	1	x	2.88	x	63.27	x	0.76	x	0.7	=	67.18	(76)
East	0.9x	1	x	2.88	x	92.28	x	0.76	x	0.7	=	97.98	(76)
East	0.9x	1	x	2.88	x	113.09	x	0.76	x	0.7	=	120.08	(76)
East	0.9x	1	x	2.88	x	115.77	x	0.76	x	0.7	=	122.92	(76)
East	0.9x	1	x	2.88	x	110.22	x	0.76	x	0.7	=	117.03	(76)
East	0.9x	1	x	2.88	x	94.68	x	0.76	x	0.7	=	100.53	(76)
East	0.9x	1	x	2.88	x	73.59	x	0.76	x	0.7	=	78.14	(76)
East	0.9x	1	x	2.88	x	45.59	x	0.76	x	0.7	=	48.41	(76)
East	0.9x	1	x	2.88	x	24.49	x	0.76	x	0.7	=	26	(76)
East	0.9x	1	x	2.88	x	16.15	x	0.76	x	0.7	=	17.15	(76)
West	0.9x	0.77	x	11.61	x	19.64	x	0.76	x	0.7	=	84.07	(80)
West	0.9x	0.77	x	11.61	x	38.42	x	0.76	x	0.7	=	164.45	(80)
West	0.9x	0.77	x	11.61	x	63.27	x	0.76	x	0.7	=	270.83	(80)
West	0.9x	0.77	x	11.61	x	92.28	x	0.76	x	0.7	=	394.99	(80)
West	0.9x	0.77	x	11.61	x	113.09	x	0.76	x	0.7	=	484.07	(80)
West	0.9x	0.77	x	11.61	x	115.77	x	0.76	x	0.7	=	495.54	(80)
West	0.9x	0.77	x	11.61	x	110.22	x	0.76	x	0.7	=	471.77	(80)
West	0.9x	0.77	x	11.61	x	94.68	x	0.76	x	0.7	=	405.24	(80)
West	0.9x	0.77	x	11.61	x	73.59	x	0.76	x	0.7	=	314.99	(80)
West	0.9x	0.77	x	11.61	x	45.59	x	0.76	x	0.7	=	195.14	(80)
West	0.9x	0.77	x	11.61	x	24.49	x	0.76	x	0.7	=	104.82	(80)
West	0.9x	0.77	x	11.61	x	16.15	x	0.76	x	0.7	=	69.13	(80)
Rooflights	0.9x	1	x	4.05	x	26.61	x	0.76	x	0.7	=	51.6	(82)
Rooflights	0.9x	1	x	5.4	x	26.61	x	0.76	x	0.7	=	68.79	(82)
Rooflights	0.9x	1	x	4.05	x	53.79	x	0.76	x	0.7	=	104.31	(82)
Rooflights	0.9x	1	x	5.4	x	53.79	x	0.76	x	0.7	=	139.08	(82)
Rooflights	0.9x	1	x	4.05	x	92.95	x	0.76	x	0.7	=	180.24	(82)
Rooflights	0.9x	1	x	5.4	x	92.95	x	0.76	x	0.7	=	240.31	(82)
Rooflights	0.9x	1	x	4.05	x	142.44	x	0.76	x	0.7	=	276.21	(82)
Rooflights	0.9x	1	x	5.4	x	142.44	x	0.76	x	0.7	=	368.28	(82)
Rooflights	0.9x	1	x	4.05	x	180.71	x	0.76	x	0.7	=	350.43	(82)
Rooflights	0.9x	1	x	5.4	x	180.71	x	0.76	x	0.7	=	467.24	(82)
Rooflights	0.9x	1	x	4.05	x	187.72	x	0.76	x	0.7	=	364.02	(82)
Rooflights	0.9x	1	x	5.4	x	187.72	x	0.76	x	0.7	=	485.36	(82)
Rooflights	0.9x	1	x	4.05	x	177.6	x	0.76	x	0.7	=	344.39	(82)
Rooflights	0.9x	1	x	5.4	x	177.6	x	0.76	x	0.7	=	459.18	(82)
Rooflights	0.9x	1	x	4.05	x	148.43	x	0.76	x	0.7	=	287.83	(82)

Rooflights 0.9x	1	x	5.4	x	148.43	x	0.76	x	0.7	=	383.77	(82)
Rooflights 0.9x	1	x	4.05	x	110.34	x	0.76	x	0.7	=	213.96	(82)
Rooflights 0.9x	1	x	5.4	x	110.34	x	0.76	x	0.7	=	285.28	(82)
Rooflights 0.9x	1	x	4.05	x	64.97	x	0.76	x	0.7	=	125.99	(82)
Rooflights 0.9x	1	x	5.4	x	64.97	x	0.76	x	0.7	=	167.99	(82)
Rooflights 0.9x	1	x	4.05	x	33.49	x	0.76	x	0.7	=	64.94	(82)
Rooflights 0.9x	1	x	5.4	x	33.49	x	0.76	x	0.7	=	86.58	(82)
Rooflights 0.9x	1	x	4.05	x	21.68	x	0.76	x	0.7	=	42.04	(82)
Rooflights 0.9x	1	x	5.4	x	21.68	x	0.76	x	0.7	=	56.06	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	225.31	448.64	758.56	1137.47	1421.82	1467.84	1392.37	1177.37	892.36	537.52	282.35	184.38	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	708.95	930	1222.87	1573.95	1828.94	1846.91	1753.92	1546.2	1276.26	949.48	726.58	653.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.85	0.66	0.47	0.34	0.41	0.69	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.89	20.29	20.71	20.93	20.99	21	21	20.94	20.55	19.99	19.59	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.01	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.95	0.82	0.6	0.4	0.27	0.32	0.61	0.93	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.76	19.01	19.4	19.8	19.97	20.02	20.02	20.02	19.99	19.66	19.12	18.71	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.23	19.63	20.03	20.22	20.26	20.27	20.27	20.23	19.89	19.34	18.94	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.83	19.08	19.48	19.88	20.07	20.11	20.12	20.12	20.08	19.74	19.19	18.79	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.98	0.94	0.81	0.6	0.41	0.28	0.33	0.61	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	705.47	915.15	1151.36	1275.34	1105.37	752.93	484.3	510.14	784.54	872.75	718.26	651.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2038.12	1986.09	1814.52	1524.66	1159.98	759.87	485.14	512.04	825.88	1266.75	1680.54	2033.72	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	991.49	719.67	493.39	179.51	40.63	0	0	0	0	293.14	692.84	1028.67

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4439.33 (98)

Space heating requirement in kWh/m²/year 34.6 (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 91.8 (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)	991.49	719.67	493.39	179.51	40.63	0	0	0	0	293.14	692.84	1028.67		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1080.05	783.96	537.46	195.54	44.26	0	0	0	0	319.32	754.73	1120.56		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4835.87	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44		
Efficiency of water heater													82.5	(216)
(217)m=	89.97	89.66	88.89	86.88	84.1	82.5	82.5	82.5	82.5	87.93	89.55	90.06		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	243.12	214.98	227.68	208.71	209.2	187.82	179.95	200.6	202.34	213.85	222.16	237.01		
Total = Sum(219a)$_{1...12}$ =													2547.4	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4835.87	
Water heating fuel used			2547.4	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			468.38	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	1044.55	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	550.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1594.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	243.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		1853.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.45	(273)
EI rating (section 14)				86	(274)

APPENDIX B3

SAP OUTPUTS FOR SAMPLE UNITS

"GREEN"

DER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 1F-3

Address : 1F-3, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.75	(1a) x	2.4	(2a) =	169.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.75	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	169.8	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.8	x1/[1/(1.4)+ 0.04]		=	5.04			(27)
Windows Type 2			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Walls Type1	47.64	21.86	25.78	x	0.15	=	3.87	14	360.92	(29)
Walls Type2	8.02	0	8.02	x	0.14	=	1.13	14	112.28	(29)
Total area of elements, m²			55.66							(31)
Party wall			31.51	x	0	=	0	20	630.2	(32)
Party floor			70.75					40	2830	(32a)
Party ceiling			70.75					30	2122.5	(32b)
Internal wall **			105.6					9	950.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7006.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 99.03 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.36 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 39.5 (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

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(38)m=	14.74	14.56	14.38	13.49	13.31	12.42	12.42	12.24	12.78	13.31	13.67	14.03	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	54.24	54.06	53.88	52.99	52.81	51.92	51.92	51.74	52.27	52.81	53.17	53.52	

Average = Sum(39)$_{1...12}$ /12= 52.94 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.77	0.76	0.76	0.75	0.75	0.73	0.73	0.73	0.74	0.75	0.75	0.76	

Average = Sum(40)$_{1...12}$ /12= 0.75 (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 2.26 (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 87.97 (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=	96.77	93.25	89.73	86.22	82.7	79.18	79.18	82.7	86.22	89.73	93.25	96.77	

Total = Sum(44)$_{1...12}$ = 1055.7 (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=	143.51	125.51	129.52	112.92	108.35	93.5	86.64	99.42	100.61	117.25	127.98	138.98	

Total = Sum(45)$_{1...12}$ = 1384.18 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.53	18.83	19.43	16.94	16.25	14.02	13	14.91	15.09	17.59	19.2	20.85	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	198.79	175.44	184.8	166.41	163.63	146.99	141.91	154.7	154.1	172.52	181.48	194.26	(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=	198.79	175.44	184.8	166.41	163.63	146.99	141.91	154.7	154.1	172.52	181.48	194.26	

Output from water heater (annual)$_{1...12}$ | 2035.02 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	91.94	81.68	87.29	80.34	80.25	73.88	73.03	77.28	76.25	83.21	85.35	90.43	(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=	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	113.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.74	15.76	12.82	9.7	7.25	6.12	6.62	8.6	11.54	14.66	17.11	18.24	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.04	201.11	195.9	184.82	170.83	157.69	148.91	146.84	152.05	163.13	177.11	190.26	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	-90.57	(71)
Water heating gains (Table 5)													
(72)m=	123.57	121.54	117.32	111.58	107.86	102.61	98.16	103.87	105.9	111.84	118.54	121.55	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	397.32	395.37	383	363.07	342.91	323.39	310.64	316.27	326.45	346.58	369.73	387.01	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.8	x	10.63	x	0.558	x	0.7	=	10.94	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.558	x	0.7	=	20.9	(74)

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North	0.9x	0.77	x	3.8	x	34.53	x	0.558	x	0.7	=	35.52	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.558	x	0.7	=	57.05	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.558	x	0.7	=	76.85	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.558	x	0.7	=	82.27	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.558	x	0.7	=	76.81	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.558	x	0.7	=	60.94	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.558	x	0.7	=	42.7	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.558	x	0.7	=	24.88	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.558	x	0.7	=	13.49	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.558	x	0.7	=	9.12	(74)
West	0.9x	0.77	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(80)
West	0.9x	0.77	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(80)
West	0.9x	0.77	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(80)
West	0.9x	0.77	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(80)
West	0.9x	0.77	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(80)
West	0.9x	0.77	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(80)
West	0.9x	0.77	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(80)
West	0.9x	0.77	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(80)
West	0.9x	0.77	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(80)
West	0.9x	0.77	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(80)
West	0.9x	0.77	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(80)
West	0.9x	0.77	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	95.79	186.88	308.87	455.71	565.43	582.42	552.97	469.95	360.62	221.83	119.29	78.89	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	493.11	582.26	691.87	818.79	908.34	905.81	863.61	786.23	687.07	568.42	489.01	465.9	(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=	0.94	0.9	0.82	0.67	0.51	0.36	0.26	0.3	0.5	0.76	0.9	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.7	19.98	20.37	20.73	20.91	20.98	21	20.99	20.94	20.66	20.12	19.65	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.28	20.28	20.29	20.3	20.3	20.31	20.31	20.31	20.31	20.3	20.3	20.29	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.89	0.8	0.65	0.48	0.32	0.22	0.26	0.45	0.73	0.89	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.53	18.93	19.47	19.97	20.21	20.29	20.31	20.31	20.25	19.89	19.15	18.47	(90)

fLA = Living area ÷ (4) = | 0.35 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.94	19.3	19.79	20.24	20.46	20.54	20.55	20.55	20.5	20.16	19.49	18.89	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.94	19.3	19.79	20.24	20.46	20.54	20.55	20.55	20.5	20.16	19.49	18.89	(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=	0.91	0.87	0.79	0.64	0.48	0.34	0.24	0.27	0.47	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	450.78	506.49	543.95	527.39	439.31	303.51	204.1	213.06	319.76	413.59	427.41	430.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	794.29	778.57	715.99	601.05	462.46	308.22	205.12	214.71	334.31	504.86	658.81	786.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	255.57	182.84	128	53.03	17.22	0	0	0	0	67.91	166.61	264.3	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1135.49 (98)

Space heating requirement in kWh/m²/year 16.05 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1135.49	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	715.36	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	476.91	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2035.02	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1282.06	(310a)

Water heat from heat source 2	(64) x (303b) x (305) x (306) =	854.71	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.29	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		137.24	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	137.24	(331)
Energy for lighting (calculated in Appendix L)		313.38	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1556.82	x	0.22		336.27	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	462.84	x	0.52		-240.22	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2790.13	x	0.22		602.67	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	829.51	x	0.52		-430.51	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	316.08	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	17.28	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	601.57	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					601.57	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	71.23	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	162.64	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					598.62	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					8.46	(384)
EI rating (section 14)						93.07	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 1F-4

Address : 1F-4, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	58.06	(1a) x	2.4	(2a) =	139.34	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	58.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		139.34	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Windows Type 2			2.4	x1/[1/(1.4)+ 0.04]		=	3.18			(27)
Floor			58.06	x	0.2	=	11.612	75	4354.5	(28)
Walls Type1	30.84	20.46	10.38	x	0.15	=	1.56	14	145.32	(29)
Walls Type2	24.12	0	24.12	x	0.14	=	3.4	14	337.68	(29)
Walls Type3	9.6	0	9.6	x	0.15	=	1.44	14	134.4	(29)
Total area of elements, m²			122.62							(31)
Party wall			16.32	x	0	=	0	20	326.4	(32)
Party ceiling			58.06					30	1741.8	(32b)
Internal wall **			81.6					9	734.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.29 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7774.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 133.9 (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 13.72 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 59.01 (37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	11.44	11.3	11.17	10.5	10.37	9.7	9.7	9.57	9.97	10.37	10.64	10.9		(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.45	70.31	70.18	69.51	69.38	68.71	68.71	68.58	68.98	69.38	69.64	69.91		
									Average = Sum(39)$_{1...12}$ /12=				69.48	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2		
									Average = Sum(40)$_{1...12}$ /12=				1.2	(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 1.93 (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 79.95 (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=	87.94	84.75	81.55	78.35	75.15	71.95	71.95	75.15	78.35	81.55	84.75	87.94		
									Total = Sum(44)$_{1...12}$ =				959.39	(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=	130.42	114.07	117.7	102.62	98.46	84.97	78.73	90.35	91.43	106.55	116.31	126.3		
									Total = Sum(45)$_{1...12}$ =				1257.91	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	19.56	17.11	17.66	15.39	14.77	12.75	11.81	13.55	13.71	15.98	17.45	18.95		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.7	163.99	172.98	156.11	153.74	138.46	134.01	145.63	144.92	161.83	169.8	181.58	(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=	185.7	163.99	172.98	156.11	153.74	138.46	134.01	145.63	144.92	161.83	169.8	181.58

Output from water heater (annual)$_{1…12}$ — 1908.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	87.59	77.87	83.36	76.92	76.96	71.05	70.4	74.26	73.19	79.65	81.47	86.22	(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=	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	96.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.98	13.31	10.82	8.19	6.12	5.17	5.59	7.26	9.75	12.37	14.44	15.4	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	168.03	169.77	165.38	156.02	144.22	133.12	125.71	123.96	128.36	137.71	149.52	160.62	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	32.63	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	-77.05	(71)

Water heating gains (Table 5)

(72)m=	117.72	115.88	112.04	106.83	103.44	98.68	94.62	99.82	101.66	107.06	113.15	115.88	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	352.63	350.85	340.13	322.94	305.68	288.86	277.81	282.93	291.66	309.03	329	343.79	(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)

North	0.9x	0.77	x	2.4	x	10.63	x	0.558	x	0.7	=	6.91	(74)
North	0.9x	0.77	x	2.4	x	20.32	x	0.558	x	0.7	=	13.2	(74)
North	0.9x	0.77	x	2.4	x	34.53	x	0.558	x	0.7	=	22.43	(74)
North	0.9x	0.77	x	2.4	x	55.46	x	0.558	x	0.7	=	36.03	(74)
North	0.9x	0.77	x	2.4	x	74.72	x	0.558	x	0.7	=	48.54	(74)
North	0.9x	0.77	x	2.4	x	79.99	x	0.558	x	0.7	=	51.96	(74)
North	0.9x	0.77	x	2.4	x	74.68	x	0.558	x	0.7	=	48.51	(74)
North	0.9x	0.77	x	2.4	x	59.25	x	0.558	x	0.7	=	38.49	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.558	x	0.7	=	26.97	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.558	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.558	x	0.7	=	8.52	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.558	x	0.7	=	5.76	(74)
East	0.9x	1	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(76)
East	0.9x	1	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(76)
East	0.9x	1	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(76)
East	0.9x	1	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(76)
East	0.9x	1	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(76)
East	0.9x	1	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(76)
East	0.9x	1	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(76)
East	0.9x	1	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(76)
East	0.9x	1	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(76)
East	0.9x	1	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(76)
East	0.9x	1	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(76)
East	0.9x	1	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	91.76	179.18	295.78	434.7	537.12	552.11	524.67	447.5	344.89	212.67	114.32	75.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	444.38	530.03	635.92	757.63	842.79	840.97	802.48	730.43	636.54	521.7	443.32	419.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.94	0.9	0.79	0.65	0.49	0.37	0.41	0.64	0.86	0.95	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.13	19.41	19.87	20.39	20.75	20.92	20.98	20.97	20.82	20.31	19.62	19.07	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.93	0.88	0.76	0.59	0.42	0.28	0.32	0.57	0.83	0.94	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.44	17.85	18.5	19.22	19.67	19.87	19.92	19.92	19.77	19.13	18.16	17.36	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.26	18.61	19.17	19.79	20.19	20.39	20.44	20.43	20.29	19.71	18.87	18.2	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.26	18.61	19.17	19.79	20.19	20.39	20.44	20.43	20.29	19.71	18.87	18.2	(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=	0.95	0.92	0.86	0.75	0.61	0.45	0.32	0.37	0.59	0.82	0.92	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.77	487.76	548.26	571.29	512.42	375.91	257.88	267.63	375.83	428.59	409.68	400.79	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	983.55	964.32	889.21	756.99	589.29	397.53	263.58	276.22	426.63	631.9	819.89	978.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	417.96	320.25	253.67	133.7	57.19	0	0	0	0	151.26	295.35	429.78	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2059.16 (98)

Space heating requirement in kWh/m²/year 35.47 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating		**kWh/year**	
Annual space heating requirement		2059.16	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1297.27	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	864.85	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement 1908.75

If DHW from community scheme:

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Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1202.51	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	801.68	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	41.66	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		112.62	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	112.62	(331)
Energy for lighting (calculated in Appendix L)		264.55	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2823.22	x	0.22		609.82	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	839.34	x	0.52		-435.62	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2617.01	x	0.22		565.27	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	778.04	x	0.52		-403.8	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	395.57	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	21.62	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	752.86	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					752.86	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	58.45	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	137.3	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					711.8	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					12.26	(384)
EI rating (section 14)						90.75	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 2F-5

Address : 2F-5, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.45	(1a) x	2.4	(2a) =	121.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.45	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		121.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			12.17	x1/[1/(1.4)+ 0.04]		=	16.13			(27)
Windows Type 2			1.68	x1/[1/(1.4)+ 0.04]		=	2.23			(27)
Walls Type1	30.27	15.95	14.32	x	0.15	=	2.15	14	200.48	(29)
Walls Type2	34.06	0	34.06	x	0.14	=	4.8	14	476.84	(29)
Total area of elements, m²			64.33							(31)
Party wall			10.8	x	0	=	0	20	216	(32)
Party floor			50.45					40	2018	(32a)
Party ceiling			50.45					30	1513.5	(32b)
Internal wall **			76.8					9	691.2	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.25 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5116.02 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 101.41 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.65 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 33.9 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	9.94	9.82	9.71	9.13	9.01	8.43	8.43	8.31	8.66	9.01	9.24	9.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	43.84	43.72	43.61	43.03	42.91	42.33	42.33	42.22	42.56	42.91	43.14	43.38	

Average = Sum(39)$_{1...12}$ /12= 43 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = Sum(40)$_{1...12}$ /12= 0.85 (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 1.7 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.65 (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=	82.12	79.13	76.15	73.16	70.18	67.19	67.19	70.18	73.16	76.15	79.13	82.12	

Total = Sum(44)$_{1...12}$ = 895.86 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.78	106.51	109.91	95.82	91.94	79.34	73.52	84.37	85.37	99.49	108.61	117.94	

Total = Sum(45)$_{1...12}$ = 1174.61 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.27	15.98	16.49	14.37	13.79	11.9	11.03	12.65	12.81	14.92	16.29	17.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	177.06	156.44	165.19	149.32	147.22	132.83	128.8	139.64	138.87	154.77	162.1	173.22	(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=	177.06	156.44	165.19	149.32	147.22	132.83	128.8	139.64	138.87	154.77	162.1	173.22	

Output from water heater (annual) 1…12	1825.45	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.71	75.36	80.77	74.66	74.79	69.18	68.67	72.27	71.18	77.3	78.91	83.44	(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=	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	85.17	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.23	11.75	9.56	7.23	5.41	4.57	4.93	6.41	8.61	10.93	12.76	13.6	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.4	149.94	146.06	137.8	127.37	117.57	111.02	109.48	113.36	121.62	132.05	141.85	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	-68.13	(71)

Water heating gains (Table 5)

(72)m=	113.86	112.14	108.56	103.69	100.53	96.08	92.29	97.14	98.86	103.9	109.59	112.15	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	324.05	322.38	312.73	297.27	281.86	266.76	256.8	261.59	269.38	285.01	302.95	316.15	(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)	
North	0.9x	0.77	x	1.68	x	10.63	x	0.558	x	0.7	=	4.84	(74)
North	0.9x	0.77	x	1.68	x	20.32	x	0.558	x	0.7	=	9.24	(74)

North	0.9x	0.77	x	1.68	x	34.53	x	0.558	x	0.7	=	15.7	(74)
North	0.9x	0.77	x	1.68	x	55.46	x	0.558	x	0.7	=	25.22	(74)
North	0.9x	0.77	x	1.68	x	74.72	x	0.558	x	0.7	=	33.98	(74)
North	0.9x	0.77	x	1.68	x	79.99	x	0.558	x	0.7	=	36.37	(74)
North	0.9x	0.77	x	1.68	x	74.68	x	0.558	x	0.7	=	33.96	(74)
North	0.9x	0.77	x	1.68	x	59.25	x	0.558	x	0.7	=	26.94	(74)
North	0.9x	0.77	x	1.68	x	41.52	x	0.558	x	0.7	=	18.88	(74)
North	0.9x	0.77	x	1.68	x	24.19	x	0.558	x	0.7	=	11	(74)
North	0.9x	0.77	x	1.68	x	13.12	x	0.558	x	0.7	=	5.97	(74)
North	0.9x	0.77	x	1.68	x	8.86	x	0.558	x	0.7	=	4.03	(74)
East	0.9x	1	x	12.17	x	19.64	x	0.56	x	0.7	=	64.7	(76)
East	0.9x	1	x	12.17	x	38.42	x	0.56	x	0.7	=	126.57	(76)
East	0.9x	1	x	12.17	x	63.27	x	0.56	x	0.7	=	208.44	(76)
East	0.9x	1	x	12.17	x	92.28	x	0.56	x	0.7	=	303.99	(76)
East	0.9x	1	x	12.17	x	113.09	x	0.56	x	0.7	=	372.56	(76)
East	0.9x	1	x	12.17	x	115.77	x	0.56	x	0.7	=	381.38	(76)
East	0.9x	1	x	12.17	x	110.22	x	0.56	x	0.7	=	363.09	(76)
East	0.9x	1	x	12.17	x	94.68	x	0.56	x	0.7	=	311.89	(76)
East	0.9x	1	x	12.17	x	73.59	x	0.56	x	0.7	=	242.42	(76)
East	0.9x	1	x	12.17	x	45.59	x	0.56	x	0.7	=	150.18	(76)
East	0.9x	1	x	12.17	x	24.49	x	0.56	x	0.7	=	80.67	(76)
East	0.9x	1	x	12.17	x	16.15	x	0.56	x	0.7	=	53.21	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	69.54	135.81	224.14	329.22	406.53	417.75	397.05	338.83	261.3	161.18	86.64	57.24	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	393.58	458.19	536.87	626.49	688.39	684.51	653.85	600.42	530.69	446.19	389.59	373.39	(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	0.89	0.82	0.69	0.53	0.38	0.28	0.32	0.51	0.76	0.89	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.85	20.25	20.65	20.87	20.97	20.99	20.99	20.92	20.58	20.02	19.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.88	0.8	0.66	0.5	0.34	0.23	0.27	0.46	0.73	0.88	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.29	18.68	19.24	19.78	20.07	20.19	20.21	20.21	20.14	19.72	18.93	18.22	(90)

fLA = Living area ÷ (4) = 0.53 (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.97	19.3	19.77	20.24	20.49	20.6	20.62	20.62	20.55	20.17	19.5	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.97	19.3	19.77	20.24	20.49	20.6	20.62	20.62	20.55	20.17	19.5	18.91	(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	0.86	0.79	0.66	0.51	0.36	0.26	0.29	0.49	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	356.41	396.05	423.06	413.33	350.38	247.38	168.63	175.66	257.54	325.69	337.39	341.9	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	642.99	629.51	578.65	487.85	377.3	253.92	170.25	178.1	274.35	410.78	535.12	637.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	213.21	156.89	115.76	53.65	20.03	0	0	0	0	63.31	142.37	220.21	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	985.44	(98)
Space heating requirement in kWh/m²/year	19.53	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		985.44	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	620.82	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	413.88	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1825.45	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1150.03	(310a)

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Water heat from heat source 2	(64) x (303b) x (305) x (306) =	766.69	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.51	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		97.86	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	97.86	(331)
Energy for lighting (calculated in Appendix L)		233.65	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1351.09	x	0.22		291.84	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	401.68	x	0.52		-208.47	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2502.79	x	0.22		540.6	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	744.08	x	0.52		-386.18	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	280.22	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	15.32	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	533.33	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					533.33	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	50.79	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	121.26	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					468.57	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					9.29	(384)
EI rating (section 14)						93.42	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 2F-6

Address : 2F-6, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.35	(1a) x	2.4	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.35	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Walls Type1	33.84	18.06	15.78	x	0.15	=	2.37	14	220.92	(29)
Walls Type2	13.51	0	13.51	x	0.14	=	1.9	14	189.14	(29)
Walls Type3	13.82	0	13.82	x	0.15	=	2.07	14	193.48	(29)
Total area of elements, m²			61.17							(31)
Party wall			21.19	x	0	=	0	20	423.8	(32)
Party floor			73.35					40	2934	(32a)
Party ceiling			73.35					30	2200.5	(32b)
Internal wall **			105.6					9	950.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7112.24 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 96.96 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.02 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 36.46 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	14.45	14.28	14.11	13.27	13.1	12.25	12.25	12.09	12.59	13.1	13.44	13.77	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	50.91	50.74	50.57	49.73	49.56	48.72	48.72	48.55	49.05	49.56	49.9	50.23	

Average = Sum(39)1...12 /12= 49.69 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.69	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.67	0.68	0.68	0.68	

Average = Sum(40)1...12 /12= 0.68 (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 2.32 (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 89.41 (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=	98.35	94.77	91.2	87.62	84.05	80.47	80.47	84.05	87.62	91.2	94.77	98.35	
									Total = Sum(44)1...12 =			1072.92	(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=	145.85	127.56	131.63	114.76	110.12	95.02	88.05	101.04	102.25	119.16	130.07	141.25	
									Total = Sum(45)1...12 =			1406.77	(45)
	If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)												
(46)m=	21.88	19.13	19.75	17.21	16.52	14.25	13.21	15.16	15.34	17.87	19.51	21.19	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.13	177.49	186.91	168.25	165.39	148.52	143.33	156.32	155.74	174.44	183.57	196.53	(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=	201.13	177.49	186.91	168.25	165.39	148.52	143.33	156.32	155.74	174.44	183.57	196.53	

Output from water heater (annual)$_{1...12}$ 2057.61 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.72	82.36	87.99	80.95	80.84	74.39	73.5	77.82	76.79	83.84	86.04	91.19	(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=	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	116.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.29	16.24	13.21	10	7.48	6.31	6.82	8.86	11.9	15.11	17.63	18.8	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	204.99	207.11	201.75	190.34	175.94	162.4	153.35	151.23	156.59	168	182.4	195.94	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	34.62	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	-92.99	(71)

Water heating gains (Table 5)

(72)m=	124.62	122.55	118.27	112.43	108.65	103.32	98.79	104.59	106.66	112.69	119.51	122.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	405.76	403.78	391.1	370.65	349.93	329.9	316.83	322.55	333.01	353.67	377.41	395.17	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	15.96	x	19.64	x	0.56	x	0.7	=	84.85	(80)
West	0.9x	0.77	x	15.96	x	38.42	x	0.56	x	0.7	=	165.98	(80)

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West	0.9x	0.77	x	15.96	x	63.27	x	0.56	x	0.7	=	273.35	(80)
West	0.9x	0.77	x	15.96	x	92.28	x	0.56	x	0.7	=	398.66	(80)
West	0.9x	0.77	x	15.96	x	113.09	x	0.56	x	0.7	=	488.58	(80)
West	0.9x	0.77	x	15.96	x	115.77	x	0.56	x	0.7	=	500.15	(80)
West	0.9x	0.77	x	15.96	x	110.22	x	0.56	x	0.7	=	476.16	(80)
West	0.9x	0.77	x	15.96	x	94.68	x	0.56	x	0.7	=	409.01	(80)
West	0.9x	0.77	x	15.96	x	73.59	x	0.56	x	0.7	=	317.92	(80)
West	0.9x	0.77	x	15.96	x	45.59	x	0.56	x	0.7	=	196.95	(80)
West	0.9x	0.77	x	15.96	x	24.49	x	0.56	x	0.7	=	105.8	(80)
West	0.9x	0.77	x	15.96	x	16.15	x	0.56	x	0.7	=	69.78	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	84.85	165.98	273.35	398.66	488.58	500.15	476.16	409.01	317.92	196.95	105.8	69.78	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	490.61	569.76	664.45	769.31	838.51	830.04	792.99	731.57	650.93	550.62	483.21	464.95	(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=	0.94	0.9	0.82	0.68	0.52	0.37	0.27	0.3	0.5	0.76	0.9	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.84	20.1	20.44	20.77	20.93	20.98	21	20.99	20.95	20.71	20.23	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.35	20.35	20.35	20.36	20.36	20.37	20.37	20.37	20.37	20.36	20.36	20.35	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.89	0.8	0.66	0.49	0.33	0.23	0.26	0.46	0.73	0.89	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.78	19.14	19.63	20.07	20.28	20.36	20.37	20.37	20.32	20.01	19.35	18.72	(90)

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.2	19.52	19.95	20.35	20.53	20.6	20.62	20.62	20.57	20.28	19.69	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.2	19.52	19.95	20.35	20.53	20.6	20.62	20.62	20.57	20.28	19.69	19.15	(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	0.87	0.79	0.65	0.5	0.35	0.25	0.28	0.47	0.73	0.87	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	448.62	496.91	526.11	503.74	417.4	288.49	194.83	203.36	305.48	401.09	422.3	429.92	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	758.56	741.69	680.03	569.2	437.81	292.5	195.66	204.66	317.42	479.97	628.4	750.83	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	230.59	164.49	114.52	47.13	15.19	0	0	0	0	58.69	148.39	238.76

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1017.76 (98)

Space heating requirement in kWh/m²/year 13.88 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1017.76	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	641.19	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	427.46	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2057.61	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1296.29	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	864.2	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	32.29	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		142.28	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	142.28	(331)
Energy for lighting (calculated in Appendix L)		322.98	(332)

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Electricity generated by PVs (Appendix M) (negative quantity)						-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)						0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1395.41	x	0.22		301.41	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	414.85	x	0.52		-215.31	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2821.09	x	0.22		609.36	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	838.71	x	0.52		-435.29	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	306.59	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	16.76	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	583.51	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					583.51	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	73.85	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	167.63	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					588.17	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					8.02	(384)
EI rating (section 14)						93.34	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 3F-7

Address : 3F-7, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	54.48	(1a)	x	2.4	(2a)	=	130.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.48	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	130.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows			12.15	x1/[1/(1.4)+ 0.04]		=	16.11			(27)
Walls Type1	31.32	14.25	17.07	x	0.15	=	2.56	14	238.98	(29)
Walls Type2	25.08	0	25.08	x	0.14	=	3.53	14	351.12	(29)
Walls Type3	12.6	0	12.6	x	0.13	=	1.67	14	176.4	(29)
Total area of elements, m²			69							(31)
Party wall			10.78	x	0	=	0	20	215.6	(32)
Party floor			54.48					40	2179.2	(32a)
Party ceiling			54.48					30	1634.4	(32b)
Internal wall **			57.6					9	518.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5314.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 97.54 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.74 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 32.54 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.73	10.61	10.48	9.85	9.73	9.1	9.1	8.98	9.35	9.73	9.98	10.23	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	43.27	43.15	43.02	42.4	42.27	41.64	41.64	41.52	41.9	42.27	42.52	42.77	

Average = Sum(39)1…12 /12= 42.37 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.79	0.79	0.79	0.78	0.78	0.76	0.76	0.76	0.77	0.78	0.78	0.79	

Average = Sum(40)1…12 /12= 0.78 (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 1.82 (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 77.48 (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=	85.22	82.12	79.02	75.93	72.83	69.73	69.73	72.83	75.93	79.02	82.12	85.22	

Total = Sum(44)1…12 = 929.7 (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=	126.38	110.54	114.06	99.44	95.42	82.34	76.3	87.55	88.6	103.25	112.71	122.39	

Total = Sum(45)1…12 = 1218.98 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.96	16.58	17.11	14.92	14.31	12.35	11.44	13.13	13.29	15.49	16.91	18.36	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	181.66	160.46	169.34	152.94	150.69	135.83	131.57	142.83	142.09	158.53	166.2	177.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.66	160.46	169.34	152.94	150.69	135.83	131.57	142.83	142.09	158.53	166.2	177.67

Output from water heater (annual)$_{1...12}$ | 1869.82 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.24	76.69	82.15	75.86	75.95	70.17	69.59	73.33	72.25	78.55	80.27	84.92	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	91.11	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.16	12.58	10.23	7.74	5.79	4.89	5.28	6.86	9.21	11.7	13.65	14.55	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	158.84	160.49	156.34	147.5	136.33	125.84	118.83	117.19	121.34	130.18	141.34	151.84	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	32.11	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	-72.88	(71)
Water heating gains (Table 5)													
(72)m=	115.92	114.13	110.41	105.36	102.08	97.46	93.54	98.57	100.35	105.58	111.49	114.14	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	339.26	337.53	327.31	310.93	294.53	278.52	267.98	272.95	281.24	297.79	316.82	330.86	(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)	
West	0.9x	0.77	x	12.15	x	19.64	x	0.56	x	0.7	=	64.59	(80)
West	0.9x	0.77	x	12.15	x	38.42	x	0.56	x	0.7	=	126.36	(80)

West	0.9x	0.77	x	12.15	x	63.27	x	0.56	x	0.7	=	208.09	(80)
West	0.9x	0.77	x	12.15	x	92.28	x	0.56	x	0.7	=	303.49	(80)
West	0.9x	0.77	x	12.15	x	113.09	x	0.56	x	0.7	=	371.94	(80)
West	0.9x	0.77	x	12.15	x	115.77	x	0.56	x	0.7	=	380.75	(80)
West	0.9x	0.77	x	12.15	x	110.22	x	0.56	x	0.7	=	362.49	(80)
West	0.9x	0.77	x	12.15	x	94.68	x	0.56	x	0.7	=	311.37	(80)
West	0.9x	0.77	x	12.15	x	73.59	x	0.56	x	0.7	=	242.02	(80)
West	0.9x	0.77	x	12.15	x	45.59	x	0.56	x	0.7	=	149.94	(80)
West	0.9x	0.77	x	12.15	x	24.49	x	0.56	x	0.7	=	80.54	(80)
West	0.9x	0.77	x	12.15	x	16.15	x	0.56	x	0.7	=	53.12	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	64.59	126.36	208.09	303.49	371.94	380.75	362.49	311.37	242.02	149.94	80.54	53.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	403.85	463.89	535.41	614.43	666.48	659.27	630.47	584.32	523.26	447.73	397.36	383.98	(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	0.89	0.82	0.7	0.54	0.39	0.29	0.32	0.52	0.76	0.89	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.93	20.3	20.67	20.88	20.97	20.99	20.99	20.93	20.62	20.1	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.26	20.26	20.26	20.27	20.27	20.28	20.28	20.29	20.28	20.27	20.27	20.27	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.88	0.8	0.67	0.51	0.35	0.24	0.27	0.47	0.73	0.88	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.84	19.36	19.87	20.14	20.26	20.28	20.28	20.21	19.82	19.09	18.42	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.02	19.34	19.78	20.23	20.48	20.58	20.6	20.6	20.53	20.18	19.54	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.02	19.34	19.78	20.23	20.48	20.58	20.6	20.6	20.53	20.18	19.54	18.97	(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	0.86	0.79	0.67	0.52	0.37	0.26	0.29	0.49	0.73	0.86	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	365.09	401.07	423.58	409.75	345.57	243.05	165.22	172.25	254.47	326.43	343.37	350.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	637.07	622.86	571.52	480.47	370.99	249	166.62	174.33	269.47	405.09	529.18	631.6	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	202.35	149.05	110.07	50.92	18.91	0	0	0	0	58.52	133.78	208.79	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 932.39 (98)

Space heating requirement in kWh/m²/year 17.11 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		932.39	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	587.41	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	391.6	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1869.82	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1177.99	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	785.33	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.42	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		105.68	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	105.68	(331)
Energy for lighting (calculated in Appendix L)		250.09	(332)

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Electricity generated by PVs (Appendix M) (negative quantity)					-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)					0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1278.36	x	0.22		276.13	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	380.06	x	0.52		-197.25	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2563.63	x	0.22		553.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	762.17	x	0.52		-395.57	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	279.36	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	15.27	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	531.69	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					531.69	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	54.85	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	129.8	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					479.51	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					8.8	(384)
EI rating (section 14)						93.54	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 3F-8

Address : 3F-8, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.7	(1a) x	2.4	(2a) =	160.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.7	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	160.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.9	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Windows Type 3			7.63	x1/[1/(1.4)+ 0.04]		=	10.12			(27)
Walls Type1	52.8	21.9	30.9	x	0.15	=	4.64	14	432.6	(29)
Walls Type2	10.39	0	10.39	x	0.14	=	1.46	14	145.46	(29)
Total area of elements, m²			63.19							(31)
Party wall			20.53	x	0	=	0	20	410.6	(32)
Party floor			66.7					40	2668	(32a)
Party ceiling			66.7					30	2001	(32b)
Internal wall **			96					9	864	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	35.29	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6521.66	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	97.78	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		5.88	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	41.17	(37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.9	13.73	13.56	12.72	12.55	11.71	11.71	11.54	12.04	12.55	12.89	13.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	55.06	54.89	54.73	53.88	53.71	52.87	52.87	52.7	53.21	53.71	54.05	54.39	

Average = Sum(39)$_{1\ldots12}$ /12= 53.84 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.83	0.82	0.82	0.81	0.81	0.79	0.79	0.79	0.8	0.81	0.81	0.82	

Average = Sum(40)$_{1\ldots12}$ /12= 0.81 (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 2.16 (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 85.58 (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=	94.14	90.72	87.29	83.87	80.45	77.02	77.02	80.45	83.87	87.29	90.72	94.14	

Total = Sum(44)$_{1\ldots12}$ = 1026.98 (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=	139.61	122.1	126	109.85	105.4	90.95	84.28	96.71	97.87	114.06	124.5	135.2	

Total = Sum(45)$_{1\ldots12}$ = 1346.53 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.94	18.32	18.9	16.48	15.81	13.64	12.64	14.51	14.68	17.11	18.68	20.28	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.88	172.03	181.27	163.34	160.68	144.45	139.56	151.99	151.36	169.33	178	190.48	(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=	194.88	172.03	181.27	163.34	160.68	144.45	139.56	151.99	151.36	169.33	178	190.48

Output from water heater (annual)$_{1...12}$ — 1997.37 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	90.64	80.54	86.12	79.32	79.27	73.04	72.24	76.38	75.34	82.15	84.19	89.18	(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=	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	108.17	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.89	15	12.2	9.24	6.9	5.83	6.3	8.19	10.99	13.95	16.29	17.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	189.48	191.44	186.49	175.94	162.62	150.11	141.75	139.78	144.74	155.29	168.6	181.12	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	33.82	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	-86.54	(71)

Water heating gains (Table 5)

(72)m=	121.83	119.85	115.75	110.17	106.54	101.44	97.1	102.66	104.63	110.41	116.93	119.86	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	383.65	381.75	369.89	350.79	331.52	312.83	300.6	306.08	315.81	335.1	357.27	373.79	(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	7.63	x	36.79	x	0.56	x	0.7	=	75.99	(77)
Southeast	0.9x	0.77	x	7.63	x	62.67	x	0.56	x	0.7	=	129.44	(77)
Southeast	0.9x	0.77	x	7.63	x	85.75	x	0.56	x	0.7	=	177.11	(77)
Southeast	0.9x	0.77	x	7.63	x	106.25	x	0.56	x	0.7	=	219.44	(77)
Southeast	0.9x	0.77	x	7.63	x	119.01	x	0.56	x	0.7	=	245.8	(77)
Southeast	0.9x	0.77	x	7.63	x	118.15	x	0.56	x	0.7	=	244.02	(77)
Southeast	0.9x	0.77	x	7.63	x	113.91	x	0.56	x	0.7	=	235.26	(77)
Southeast	0.9x	0.77	x	7.63	x	104.39	x	0.56	x	0.7	=	215.6	(77)
Southeast	0.9x	0.77	x	7.63	x	92.85	x	0.56	x	0.7	=	191.77	(77)
Southeast	0.9x	0.77	x	7.63	x	69.27	x	0.56	x	0.7	=	143.06	(77)
Southeast	0.9x	0.77	x	7.63	x	44.07	x	0.56	x	0.7	=	91.02	(77)
Southeast	0.9x	0.77	x	7.63	x	31.49	x	0.56	x	0.7	=	65.03	(77)
South	0.9x	0.77	x	3.82	x	46.75	x	0.56	x	0.7	=	48.34	(78)
South	0.9x	0.77	x	3.82	x	76.57	x	0.56	x	0.7	=	79.17	(78)
South	0.9x	0.77	x	3.82	x	97.53	x	0.56	x	0.7	=	100.85	(78)
South	0.9x	0.77	x	3.82	x	110.23	x	0.56	x	0.7	=	113.98	(78)
South	0.9x	0.77	x	3.82	x	114.87	x	0.56	x	0.7	=	118.78	(78)
South	0.9x	0.77	x	3.82	x	110.55	x	0.56	x	0.7	=	114.31	(78)
South	0.9x	0.77	x	3.82	x	108.01	x	0.56	x	0.7	=	111.69	(78)
South	0.9x	0.77	x	3.82	x	104.89	x	0.56	x	0.7	=	108.46	(78)
South	0.9x	0.77	x	3.82	x	101.89	x	0.56	x	0.7	=	105.35	(78)
South	0.9x	0.77	x	3.82	x	82.59	x	0.56	x	0.7	=	85.4	(78)
South	0.9x	0.77	x	3.82	x	55.42	x	0.56	x	0.7	=	57.3	(78)
South	0.9x	0.77	x	3.82	x	40.4	x	0.56	x	0.7	=	41.77	(78)
West	0.9x	0.77	x	8.35	x	19.64	x	0.56	x	0.7	=	44.39	(80)
West	0.9x	0.77	x	8.35	x	38.42	x	0.56	x	0.7	=	86.84	(80)
West	0.9x	0.77	x	8.35	x	63.27	x	0.56	x	0.7	=	143.01	(80)
West	0.9x	0.77	x	8.35	x	92.28	x	0.56	x	0.7	=	208.57	(80)
West	0.9x	0.77	x	8.35	x	113.09	x	0.56	x	0.7	=	255.62	(80)
West	0.9x	0.77	x	8.35	x	115.77	x	0.56	x	0.7	=	261.67	(80)
West	0.9x	0.77	x	8.35	x	110.22	x	0.56	x	0.7	=	249.12	(80)
West	0.9x	0.77	x	8.35	x	94.68	x	0.56	x	0.7	=	213.99	(80)
West	0.9x	0.77	x	8.35	x	73.59	x	0.56	x	0.7	=	166.33	(80)
West	0.9x	0.77	x	8.35	x	45.59	x	0.56	x	0.7	=	103.04	(80)
West	0.9x	0.77	x	8.35	x	24.49	x	0.56	x	0.7	=	55.35	(80)
West	0.9x	0.77	x	8.35	x	16.15	x	0.56	x	0.7	=	36.51	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	168.73	295.45	420.97	542	620.19	620	596.07	538.05	463.45	331.5	203.67	143.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	552.37	677.2	790.86	892.8	951.71	932.83	896.67	844.14	779.26	666.6	560.95	517.1	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.91	0.85	0.76	0.63	0.49	0.35	0.26	0.28	0.45	0.69	0.86	0.92	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.72	20.06	20.42	20.73	20.9	20.98	20.99	20.99	20.95	20.7	20.17	19.66	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.23	20.23	20.24	20.25	20.25	20.26	20.26	20.26	20.26	20.25	20.24	20.24	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.9	0.84	0.74	0.61	0.46	0.32	0.21	0.24	0.41	0.66	0.85	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.53	19	19.5	19.93	20.14	20.24	20.26	20.26	20.2	19.9	19.18	18.44	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.48	19.91	20.29	20.49	20.57	20.59	20.59	20.54	20.26	19.63	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.48	19.91	20.29	20.49	20.57	20.59	20.59	20.54	20.26	19.63	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.82	0.73	0.61	0.47	0.33	0.23	0.26	0.42	0.66	0.83	0.9	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	488.18	556.14	579.83	542.31	446.34	309.75	209.56	218.79	329.19	441.15	465.65	464.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	813.3	800.32	734.08	613.88	472.03	315.76	210.96	220.77	342.68	519.01	677.18	804.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	241.89	164.09	114.76	51.53	19.12	0	0	0	0	57.92	152.3	253.04	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1054.66 (98)

Space heating requirement in kWh/m²/year 15.81 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)

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Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1054.66	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	664.43	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	442.96	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1997.37	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1258.34	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	838.89	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	32.05	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		129.38	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	129.38	(331)
Energy for lighting (calculated in Appendix L)		298.32	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1445.99	x	0.22		312.33	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	429.89	x	0.52		-223.12	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2738.5	x	0.22		591.52	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	814.16	x	0.52		-422.55	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	304.26	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	16.63	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	579.08	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)

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CO_2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO_2 associated with space and water heating	(373) + (374) + (375) =			579.08	(376)
CO_2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	67.15	(378)
CO_2 associated with electricity for lighting	(332))) x	0.52	=	154.83	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-236.82	(380)
Total CO_2, kg/year	sum of (376)…(382) =			564.24	(383)
Dwelling CO_2 Emission Rate	(383) ÷ (4) =			8.46	(384)
EI rating (section 14)				93.23	(385)

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User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 4F-10

Address : 4F-10, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	86.56	(1a) x	2.4	(2a) =	207.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.56	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	207.74	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.22	x1/[1/(1.4)+ 0.04]		=	20.18			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Walls Type1	52.25	25.67	26.58	x	0.15	=	3.99	14	372.12	(29)
Walls Type2	17.09	0	17.09	x	0.14	=	2.41	14	239.26	(29)
Roof	86.56	0	86.56	x	0.11	=	9.52	9	779.04	(30)
Total area of elements, m²			155.9							(31)
Party wall			32.95	x	0	=	0	20	659	(32)
Party floor			86.56					40	3462.4	(32a)
Internal wall **			163.2					9	1468.8	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 50.1 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6980.62 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 80.64 (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 12.37 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 62.47 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	18.03	17.82	17.6	16.5	16.29	15.19	15.19	14.98	15.63	16.29	16.72	17.16		(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	80.51	80.29	80.07	78.98	78.76	77.67	77.67	77.45	78.11	78.76	79.2	79.64		

Average = Sum(39)$_{1...12}$ /12= 78.92 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.91	0.92	

Average = Sum(40)$_{1...12}$ /12= 0.91 (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 2.58 (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 95.37 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	104.91	101.09	97.28	93.46	89.65	85.83	85.83	89.65	93.46	97.28	101.09	104.91

Total = Sum(44)$_{1...12}$ = 1144.46 (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=	155.58	136.07	140.41	122.41	117.46	101.36	93.92	107.78	109.06	127.1	138.74	150.67

Total = Sum(45)$_{1...12}$ = 1500.57 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.34	20.41	21.06	18.36	17.62	15.2	14.09	16.17	16.36	19.07	20.81	22.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)		
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)		
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/year (48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
If community heating see section 4.3		
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.6	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94	(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=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94

Output from water heater (annual)$_{1...12}$ | 2151.41 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	95.95	85.18	90.91	83.5	83.28	76.5	75.45	80.06	79.06	86.48	88.93	94.32	(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=	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.74	18.42	14.98	11.34	8.48	7.16	7.73	10.05	13.49	17.13	19.99	21.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	232.6	235.02	228.94	215.99	199.64	184.28	174.02	171.6	177.68	190.63	206.98	222.34	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	(71)

Water heating gains (Table 5)

(72)m=	128.97	126.76	122.19	115.97	111.93	106.24	101.41	107.6	109.8	116.24	123.51	126.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	443.94	441.83	427.74	404.93	381.68	359.32	344.8	350.89	362.61	385.64	412.12	432.06	(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)	
North	0.9x	0.77	x	8.35	x	10.63	x	0.558	x	0.7	=	24.03	(74)
North	0.9x	0.77	x	8.35	x	20.32	x	0.558	x	0.7	=	45.93	(74)

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North	0.9x	0.77	x	8.35	x	34.53	x	0.558	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	8.35	x	55.46	x	0.558	x	0.7	=	125.36	(74)
North	0.9x	0.77	x	8.35	x	74.72	x	0.558	x	0.7	=	168.87	(74)
North	0.9x	0.77	x	8.35	x	79.99	x	0.558	x	0.7	=	180.79	(74)
North	0.9x	0.77	x	8.35	x	74.68	x	0.558	x	0.7	=	168.79	(74)
North	0.9x	0.77	x	8.35	x	59.25	x	0.558	x	0.7	=	133.91	(74)
North	0.9x	0.77	x	8.35	x	41.52	x	0.558	x	0.7	=	93.84	(74)
North	0.9x	0.77	x	8.35	x	24.19	x	0.558	x	0.7	=	54.67	(74)
North	0.9x	0.77	x	8.35	x	13.12	x	0.558	x	0.7	=	29.65	(74)
North	0.9x	0.77	x	8.35	x	8.86	x	0.558	x	0.7	=	20.04	(74)
East	0.9x	1	x	15.22	x	19.64	x	0.56	x	0.7	=	80.91	(76)
East	0.9x	1	x	15.22	x	38.42	x	0.56	x	0.7	=	158.29	(76)
East	0.9x	1	x	15.22	x	63.27	x	0.56	x	0.7	=	260.68	(76)
East	0.9x	1	x	15.22	x	92.28	x	0.56	x	0.7	=	380.18	(76)
East	0.9x	1	x	15.22	x	113.09	x	0.56	x	0.7	=	465.92	(76)
East	0.9x	1	x	15.22	x	115.77	x	0.56	x	0.7	=	476.96	(76)
East	0.9x	1	x	15.22	x	110.22	x	0.56	x	0.7	=	454.08	(76)
East	0.9x	1	x	15.22	x	94.68	x	0.56	x	0.7	=	390.05	(76)
East	0.9x	1	x	15.22	x	73.59	x	0.56	x	0.7	=	303.18	(76)
East	0.9x	1	x	15.22	x	45.59	x	0.56	x	0.7	=	187.82	(76)
East	0.9x	1	x	15.22	x	24.49	x	0.56	x	0.7	=	100.89	(76)
East	0.9x	1	x	15.22	x	16.15	x	0.56	x	0.7	=	66.54	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	104.95	204.22	338.72	505.54	634.8	657.74	622.87	523.96	397.01	242.49	130.54	86.58	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	548.89	646.05	766.46	910.47	1016.48	1017.06	967.66	874.85	759.63	628.13	542.66	518.64	(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=	0.94	0.91	0.85	0.74	0.6	0.45	0.34	0.38	0.59	0.81	0.91	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.88	19.2	19.7	20.28	20.68	20.89	20.96	20.95	20.77	20.21	19.44	18.83	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.9	0.84	0.72	0.56	0.4	0.28	0.32	0.54	0.79	0.9	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.29	17.74	18.45	19.26	19.8	20.07	20.14	20.13	19.93	19.18	18.11	17.21	(90)

fLA = Living area ÷ (4) = | 0.28 | (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.73	18.14	18.8	19.55	20.04	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.73	18.14	18.8	19.55	20.04	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(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	0.87	0.81	0.7	0.56	0.41	0.29	0.34	0.54	0.76	0.88	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	498.31	563.31	618.37	633.32	564.9	414	284.33	294.23	411.81	479.05	475.16	475.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1081.22	1063.43	984.82	840.83	657.14	442.6	292.9	306.62	473.72	698.45	901.19	1071.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	433.69	336.08	272.64	149.41	68.63	0	0	0	0	163.24	306.74	443.57	

Total per year (kWh/year) = Sum(98)1...5,9...12 =	2173.98	(98)
Space heating requirement in kWh/m²/year	25.12	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2173.98	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1369.61	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	913.07	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2151.41	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1355.39	(310a)

DER WorkSheet: New dwelling design stage

Water heat from heat source 2	(64) x (303b) x (305) x (306) =	903.59	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	45.42	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		167.91	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	167.91	(331)
Energy for lighting (calculated in Appendix L)		366.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2980.64	x	0.22		643.82	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	886.15	x	0.52		-459.91	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2949.7	x	0.22		637.13	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	876.95	x	0.52		-455.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	431.21	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	23.57	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	820.69	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					820.69	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	87.14	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	190.07	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					861.08	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					9.95	(384)
EI rating (section 14)						91.23	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 4F-9

Address : 4F-9, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	86.56	(1a) x	2.4	(2a) =	207.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.56	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	207.74	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			15.22	x1/[1/(1.4)+ 0.04]		=	20.18			(27)
Windows Type 2			8.35	x1/[1/(1.4)+ 0.04]		=	11.07			(27)
Walls Type1	51.14	25.67	25.47	x	0.15	=	3.82	14	356.58	(29)
Walls Type2	8.21	0	8.21	x	0.14	=	1.16	14	114.94	(29)
Walls Type3	9.98	0	9.98	x	0.13	=	1.32	14	139.72	(29)
Roof	86.56	0	86.56	x	0.11	=	9.52	9	779.04	(30)
Total area of elements, m²			155.89							(31)
Party wall			32.95	x	0	=	0	20	659	(32)
Party floor			86.56					40	3462.4	(32a)
Internal wall **			163.2					9	1468.8	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	50.01	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6980.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	80.64	(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 12.37 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 62.38 (37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.03	17.82	17.6	16.5	16.29	15.19	15.19	14.98	15.63	16.29	16.72	17.16	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	80.41	80.19	79.97	78.88	78.66	77.57	77.57	77.35	78.01	78.66	79.1	79.54	

Average = $Sum(39)_{1...12}$ /12= 78.83 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.92	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.91	0.92	

Average = $Sum(40)_{1...12}$ /12= 0.91 (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 2.58 (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 95.37 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	104.91	101.09	97.28	93.46	89.65	85.83	85.83	89.65	93.46	97.28	101.09	104.91

Total = $Sum(44)_{1...12}$ = 1144.46 (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=	155.58	136.07	140.41	122.41	117.46	101.36	93.92	107.78	109.06	127.1	138.74	150.67

Total = $Sum(45)_{1...12}$ = 1500.57 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.34	20.41	21.06	18.36	17.62	15.2	14.09	16.17	16.36	19.07	20.81	22.6	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94	(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=	210.85	186	195.69	175.91	172.74	154.85	149.2	163.05	162.56	182.38	192.24	205.94

Output from water heater (annual)$_{1...12}$ — 2151.41 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	95.95	85.18	90.91	83.5	83.28	76.5	75.45	80.06	79.06	86.48	88.93	94.32	(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=	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	128.78	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.74	18.42	14.98	11.34	8.48	7.16	7.73	10.05	13.49	17.13	19.99	21.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	232.6	235.02	228.94	215.99	199.64	184.28	174.02	171.6	177.68	190.63	206.98	222.34	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	35.88	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	-103.03	(71)

Water heating gains (Table 5)

(72)m=	128.97	126.76	122.19	115.97	111.93	106.24	101.41	107.6	109.8	116.24	123.51	126.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	443.94	441.83	427.74	404.93	381.68	359.32	344.8	350.89	362.61	385.64	412.12	432.06	(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)

North	0.9x	0.77	x	8.35	x	10.63	x	0.558	x	0.7	=	24.03	(74)
North	0.9x	0.77	x	8.35	x	20.32	x	0.558	x	0.7	=	45.93	(74)
North	0.9x	0.77	x	8.35	x	34.53	x	0.558	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	8.35	x	55.46	x	0.558	x	0.7	=	125.36	(74)
North	0.9x	0.77	x	8.35	x	74.72	x	0.558	x	0.7	=	168.87	(74)
North	0.9x	0.77	x	8.35	x	79.99	x	0.558	x	0.7	=	180.79	(74)
North	0.9x	0.77	x	8.35	x	74.68	x	0.558	x	0.7	=	168.79	(74)
North	0.9x	0.77	x	8.35	x	59.25	x	0.558	x	0.7	=	133.91	(74)
North	0.9x	0.77	x	8.35	x	41.52	x	0.558	x	0.7	=	93.84	(74)
North	0.9x	0.77	x	8.35	x	24.19	x	0.558	x	0.7	=	54.67	(74)
North	0.9x	0.77	x	8.35	x	13.12	x	0.558	x	0.7	=	29.65	(74)
North	0.9x	0.77	x	8.35	x	8.86	x	0.558	x	0.7	=	20.04	(74)
West	0.9x	0.77	x	15.22	x	19.64	x	0.56	x	0.7	=	80.91	(80)
West	0.9x	0.77	x	15.22	x	38.42	x	0.56	x	0.7	=	158.29	(80)
West	0.9x	0.77	x	15.22	x	63.27	x	0.56	x	0.7	=	260.68	(80)
West	0.9x	0.77	x	15.22	x	92.28	x	0.56	x	0.7	=	380.18	(80)
West	0.9x	0.77	x	15.22	x	113.09	x	0.56	x	0.7	=	465.92	(80)
West	0.9x	0.77	x	15.22	x	115.77	x	0.56	x	0.7	=	476.96	(80)
West	0.9x	0.77	x	15.22	x	110.22	x	0.56	x	0.7	=	454.08	(80)
West	0.9x	0.77	x	15.22	x	94.68	x	0.56	x	0.7	=	390.05	(80)
West	0.9x	0.77	x	15.22	x	73.59	x	0.56	x	0.7	=	303.18	(80)
West	0.9x	0.77	x	15.22	x	45.59	x	0.56	x	0.7	=	187.82	(80)
West	0.9x	0.77	x	15.22	x	24.49	x	0.56	x	0.7	=	100.89	(80)
West	0.9x	0.77	x	15.22	x	16.15	x	0.56	x	0.7	=	66.54	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	104.95	204.22	338.72	505.54	634.8	657.74	622.87	523.96	397.01	242.49	130.54	86.58	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	548.89	646.05	766.46	910.47	1016.48	1017.06	967.66	874.85	759.63	628.13	542.66	518.64	(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=	0.94	0.91	0.85	0.74	0.6	0.45	0.34	0.38	0.59	0.81	0.91	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.89	19.2	19.7	20.28	20.68	20.9	20.96	20.95	20.77	20.21	19.45	18.83	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.9	0.84	0.72	0.56	0.4	0.28	0.32	0.54	0.79	0.9	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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(90)m=	17.29	17.74	18.46	19.27	19.8	20.07	20.14	20.13	19.93	19.19	18.11	17.21	(90)

fLA = Living area ÷ (4) = | 0.28 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.73	18.15	18.8	19.55	20.05	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.73	18.15	18.8	19.55	20.05	20.3	20.37	20.36	20.17	19.47	18.48	17.66	(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	0.87	0.81	0.7	0.56	0.41	0.29	0.34	0.54	0.76	0.88	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	498.3	563.28	618.28	633.13	564.59	413.68	284.08	293.98	411.58	478.95	475.13	475.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1080.25	1062.47	983.92	840.02	656.47	442.13	292.59	306.3	473.24	697.8	900.37	1070.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	432.98	335.46	272.03	148.97	68.36	0	0	0	0	162.83	306.17	442.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2169.64 | (98)

Space heating requirement in kWh/m²/year | 25.07 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2169.64	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1366.88	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	911.25	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement | 2151.41

If DHW from community scheme:

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Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1355.39	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	903.59	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	45.37	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		167.91	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	167.91	(331)
Energy for lighting (calculated in Appendix L)		366.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		29.73	(361)
Heat efficiency of CHP unit		45.95	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2974.7	x	0.22		642.54	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	884.38	x	0.52		-458.99	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2949.7	x	0.22		637.13	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	876.95	x	0.52		-455.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	430.78	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	23.55	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	819.87	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					819.87	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	87.14	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	190.07	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					860.26	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					9.94	(384)
EI rating (section 14)						91.24	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Matthew Stainrod
Stroma Number: STRO023501
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.16

Property Address: 06-18-69419 GF-1

Address : GF-1, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	73.52	(1a)	x	2.4	(2a)	=	176.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.52	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	176.45	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.8	x1/[1/(1.4)+ 0.04]		=	5.04			(27)
Windows Type 2			15.96	x1/[1/(1.4)+ 0.04]		=	21.16			(27)
Floor			73.52	x	0.11	=	8.087199	110	8087.2	(28)
Walls Type1	47.64	21.86	25.78	x	0.15	=	3.87	14	360.92	(29)
Walls Type2	2.4	0	2.4	x	0.14	=	0.34	14	33.6	(29)
Total area of elements, m²			123.56							(31)
Party wall			37.13	x	0	=	0	20	742.6	(32)
Party ceiling			73.52					30	2205.6	(32b)
Internal wall **			110.4					9	993.6	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.43 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12423.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 168.98 (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 9.46 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 50.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	14.48	14.31	14.14	13.3	13.13	12.28	12.28	12.11	12.62	13.13	13.47	13.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	65.37	65.2	65.03	64.19	64.02	63.17	63.17	63	63.51	64.02	64.36	64.7	

Average = Sum(39)$_{1...12}$ /12= 64.15 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.87	0.88	0.88	

Average = Sum(40)$_{1...12}$ /12= 0.87 (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 2.33 (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 89.5 (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=	98.45	94.87	91.29	87.71	84.13	80.55	80.55	84.13	87.71	91.29	94.87	98.45

Total = Sum(44)$_{1...12}$ = 1074.01 (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=	146	127.69	131.77	114.88	110.23	95.12	88.14	101.14	102.35	119.28	130.2	141.39

Total = Sum(45)$_{1...12}$ = 1408.2 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.9	19.15	19.77	17.23	16.53	14.27	13.22	15.17	15.35	17.89	19.53	21.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.28	177.62	187.04	168.37	165.5	148.61	143.42	156.42	155.85	174.56	183.7	196.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.28	177.62	187.04	168.37	165.5	148.61	143.42	156.42	155.85	174.56	183.7	196.67

Output from water heater (annual)$_{1...12}$ | 2059.04 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.77	82.4	88.03	80.99	80.87	74.42	73.53	77.85	76.83	83.88	86.09	91.23	(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=	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	116.42	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.31	16.26	13.22	10.01	7.48	6.32	6.83	8.87	11.91	15.12	17.65	18.82	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	205.37	207.5	202.13	190.7	176.27	162.7	153.64	151.51	156.88	168.31	182.74	196.31	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	-93.14	(71)

Water heating gains (Table 5)

(72)m=	124.69	122.62	118.33	112.49	108.7	103.36	98.83	104.64	106.7	112.74	119.57	122.63	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	406.29	404.31	391.61	371.13	350.38	330.31	317.22	322.95	333.42	354.11	377.89	395.68	(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)	
North	0.9x	0.77	x	3.8	x	10.63	x	0.48	x	0.7	=	9.41	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.48	x	0.7	=	17.98	(74)

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North	0.9x	0.77	x	3.8	x	34.53	x	0.48	x	0.7	=	30.55	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.48	x	0.7	=	49.08	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.48	x	0.7	=	66.11	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.48	x	0.7	=	70.77	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.48	x	0.7	=	66.08	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.48	x	0.7	=	52.42	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.48	x	0.7	=	36.73	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.48	x	0.7	=	21.4	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.48	x	0.7	=	11.61	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.48	x	0.7	=	7.84	(74)
East	0.9x	1	x	15.96	x	19.64	x	0.48	x	0.7	=	72.99	(76)
East	0.9x	1	x	15.96	x	38.42	x	0.48	x	0.7	=	142.78	(76)
East	0.9x	1	x	15.96	x	63.27	x	0.48	x	0.7	=	235.14	(76)
East	0.9x	1	x	15.96	x	92.28	x	0.48	x	0.7	=	342.94	(76)
East	0.9x	1	x	15.96	x	113.09	x	0.48	x	0.7	=	420.28	(76)
East	0.9x	1	x	15.96	x	115.77	x	0.48	x	0.7	=	430.23	(76)
East	0.9x	1	x	15.96	x	110.22	x	0.48	x	0.7	=	409.6	(76)
East	0.9x	1	x	15.96	x	94.68	x	0.48	x	0.7	=	351.84	(76)
East	0.9x	1	x	15.96	x	73.59	x	0.48	x	0.7	=	273.48	(76)
East	0.9x	1	x	15.96	x	45.59	x	0.48	x	0.7	=	169.42	(76)
East	0.9x	1	x	15.96	x	24.49	x	0.48	x	0.7	=	91.01	(76)
East	0.9x	1	x	15.96	x	16.15	x	0.48	x	0.7	=	60.02	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	82.4	160.76	265.69	392.01	486.39	501.01	475.67	404.26	310.21	190.82	102.61	67.87	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	488.69	565.07	657.3	763.14	836.77	831.32	792.9	727.21	643.63	544.93	480.5	463.55	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.93	0.83	0.66	0.48	0.35	0.4	0.64	0.89	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.88	20.08	20.39	20.73	20.92	20.99	21	21	20.95	20.67	20.21	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.18	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.92	0.8	0.62	0.42	0.29	0.33	0.58	0.87	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.68	18.97	19.41	19.88	20.11	20.19	20.2	20.2	20.16	19.81	19.17	18.63	(90)

fLA = Living area ÷ (4) = | 0.36 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.11	19.37	19.76	20.19	20.4	20.48	20.49	20.49	20.44	20.12	19.54	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.11	19.37	19.76	20.19	20.4	20.48	20.49	20.49	20.44	20.12	19.54	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.91	0.8	0.63	0.44	0.31	0.35	0.6	0.86	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	477.41	541.42	598.73	609.7	525.19	366.34	244.81	256.15	384.15	470.74	460.79	454.76	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	968.13	943.27	862.61	724.47	557.25	371.27	245.55	257.48	402.74	609.34	800.81	961.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	365.09	270.04	196.33	82.63	23.85	0	0	0	0	103.12	244.82	377.19	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1663.08 (98)

Space heating requirement in kWh/m²/year 22.62 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1663.08	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1047.74	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	698.49	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2059.04	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1297.19	(310a)

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Water heat from heat source 2	(64) x (303b) x (305) x (306) =	864.8	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	39.08	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		142.61	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	142.61	(331)
Energy for lighting (calculated in Appendix L)		323.34	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2280.17	x	0.22		492.52	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	677.9	x	0.52		-351.83	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2823.06	x	0.22		609.78	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	839.29	x	0.52		-435.59	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	371.07	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	20.28	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	706.23	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					706.23	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	74.02	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	167.81	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					711.24	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					9.67	(384)
EI rating (section 14)						91.96	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 GF-2

Address : GF-2, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	90.93	(1a) x	2.4	(2a) =	218.23	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.93	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	218.23	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.9 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			12.15	x1/[1/(1.4)+ 0.04]		=	16.11			(27)
Windows Type 2			7.63	x1/[1/(1.4)+ 0.04]		=	10.12			(27)
Floor			90.93	x	0.11	=	10.0023	110	10002.3	(28)
Walls Type1	77.99	21.88	56.11	x	0.15	=	8.42	14	785.54	(29)
Walls Type2	3.6	0	3.6	x	0.14	=	0.51	14	50.4	(29)
Walls Type3	4.8	0	4.8	x	0.15	=	0.72	14	67.2	(29)
Total area of elements, m²			177.32							(31)
Party wall			22.8	x	0	=	0	20	456	(32)
Party ceiling			90.93					30	2727.9	(32b)
Internal wall **			153.6					9	1382.4	(32c)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	48.81	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	15471.74	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	170.15	(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 12.2 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 61.01 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.94	18.72	18.49	17.34	17.11	15.96	15.96	15.73	16.42	17.11	17.57	18.03	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.96	79.73	79.5	78.35	78.12	76.97	76.97	76.74	77.43	78.12	78.58	79.04	

Average = Sum(39)$_{1…12}$ /12= 78.29 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.88	0.88	0.87	0.86	0.86	0.85	0.85	0.84	0.85	0.86	0.86	0.87	

Average = Sum(40)$_{1…12}$ /12= 0.86 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.64 (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 96.86 (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=	106.54	102.67	98.8	94.92	91.05	87.17	87.17	91.05	94.92	98.8	102.67	106.54	

Total = Sum(44)$_{1…12}$ = 1162.3 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	158	138.19	142.6	124.32	119.29	102.94	95.39	109.46	110.76	129.09	140.91	153.02	

Total = Sum(45)$_{1…12}$ = 1523.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.7	20.73	21.39	18.65	17.89	15.44	14.31	16.42	16.61	19.36	21.14	22.95	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	213.28	188.12	197.88	177.81	174.57	156.43	150.66	164.73	164.26	184.36	194.4	208.29	(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=	213.28	188.12	197.88	177.81	174.57	156.43	150.66	164.73	164.26	184.36	194.4	208.29

Output from water heater (annual)$_{1...12}$ — 2174.8 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	96.76	85.89	91.64	84.13	83.89	77.02	75.94	80.62	79.62	87.14	89.65	95.1	(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=	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	131.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.48	19.08	15.52	11.75	8.78	7.41	8.01	10.41	13.98	17.75	20.71	22.08	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	240.78	243.28	236.98	223.58	206.66	190.75	180.13	177.63	183.93	197.33	214.25	230.15	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	36.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	-105.53	(71)

Water heating gains (Table 5)

(72)m=	130.05	127.81	123.17	116.85	112.75	106.97	102.07	108.35	110.59	117.13	124.51	127.82	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	454.88	452.74	438.24	414.75	390.76	367.72	352.78	358.97	371.07	394.78	422.05	442.63	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.77	x	7.63	x	36.79	x	0.44	x	0.7	=	59.92	(77)
Southeast	0.9x	0.77	x	7.63	x	62.67	x	0.44	x	0.7	=	102.07	(77)
Southeast	0.9x	0.77	x	7.63	x	85.75	x	0.44	x	0.7	=	139.65	(77)
Southeast	0.9x	0.77	x	7.63	x	106.25	x	0.44	x	0.7	=	173.04	(77)
Southeast	0.9x	0.77	x	7.63	x	119.01	x	0.44	x	0.7	=	193.82	(77)
Southeast	0.9x	0.77	x	7.63	x	118.15	x	0.44	x	0.7	=	192.42	(77)
Southeast	0.9x	0.77	x	7.63	x	113.91	x	0.44	x	0.7	=	185.51	(77)
Southeast	0.9x	0.77	x	7.63	x	104.39	x	0.44	x	0.7	=	170.01	(77)
Southeast	0.9x	0.77	x	7.63	x	92.85	x	0.44	x	0.7	=	151.22	(77)
Southeast	0.9x	0.77	x	7.63	x	69.27	x	0.44	x	0.7	=	112.81	(77)
Southeast	0.9x	0.77	x	7.63	x	44.07	x	0.44	x	0.7	=	71.77	(77)
Southeast	0.9x	0.77	x	7.63	x	31.49	x	0.44	x	0.7	=	51.28	(77)
South	0.9x	0.77	x	12.15	x	46.75	x	0.44	x	0.7	=	121.24	(78)
South	0.9x	0.77	x	12.15	x	76.57	x	0.44	x	0.7	=	198.57	(78)
South	0.9x	0.77	x	12.15	x	97.53	x	0.44	x	0.7	=	252.94	(78)
South	0.9x	0.77	x	12.15	x	110.23	x	0.44	x	0.7	=	285.88	(78)
South	0.9x	0.77	x	12.15	x	114.87	x	0.44	x	0.7	=	297.9	(78)
South	0.9x	0.77	x	12.15	x	110.55	x	0.44	x	0.7	=	286.69	(78)
South	0.9x	0.77	x	12.15	x	108.01	x	0.44	x	0.7	=	280.11	(78)
South	0.9x	0.77	x	12.15	x	104.89	x	0.44	x	0.7	=	272.03	(78)
South	0.9x	0.77	x	12.15	x	101.89	x	0.44	x	0.7	=	264.22	(78)
South	0.9x	0.77	x	12.15	x	82.59	x	0.44	x	0.7	=	214.17	(78)
South	0.9x	0.77	x	12.15	x	55.42	x	0.44	x	0.7	=	143.72	(78)
South	0.9x	0.77	x	12.15	x	40.4	x	0.44	x	0.7	=	104.77	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	181.17	300.64	392.59	458.91	491.72	479.11	465.62	442.04	415.44	326.98	215.49	156.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	636.05	753.38	830.83	873.66	882.48	846.82	818.4	801.01	786.51	721.76	637.53	598.68	(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=	0.98	0.96	0.93	0.86	0.74	0.56	0.41	0.44	0.64	0.87	0.96	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.95	20.17	20.43	20.7	20.88	20.98	21	20.99	20.95	20.72	20.29	19.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.2	20.2	20.21	20.21	20.22	20.21	20.2	20.2	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.91	0.83	0.69	0.5	0.34	0.36	0.58	0.84	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.78	19.1	19.47	19.85	20.08	20.19	20.21	20.21	20.17	19.89	19.28	18.73	(90)

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.18	19.47	19.8	20.14	20.36	20.46	20.48	20.48	20.44	20.18	19.63	19.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.18	19.47	19.8	20.14	20.36	20.46	20.48	20.48	20.44	20.18	19.63	19.13	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.95	0.9	0.83	0.7	0.52	0.36	0.39	0.6	0.84	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	618.76	713.65	751.74	722.16	617.84	440.19	297.12	310.97	469.28	604.82	604.91	585.61	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1190.1	1161.88	1057.64	880.88	676.51	451.29	298.75	313.22	490.87	748.08	984.74	1180.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	425.07	301.21	227.59	114.28	43.66	0	0	0	0	106.59	273.47	442.44	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1934.31 (98)

Space heating requirement in kWh/m²/year 21.27 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1934.31	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1218.61	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	812.41	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement 2174.8

If DHW from community scheme:

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Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1370.12	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	913.41	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	43.15	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		176.39	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	176.39	(331)
Energy for lighting (calculated in Appendix L)		379.38	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-456.3	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						29.73	(361)
Heat efficiency of CHP unit						45.95	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2652.04	x	0.22		572.84	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	788.45	x	0.52		-409.21	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2981.77	x	0.22		644.06	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	886.48	x	0.52		-460.08	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					91	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	409.65	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	22.39	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	779.65	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					779.65	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	91.54	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	196.9	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-236.82	(380)
Total CO2, kg/year	sum of (376)…(382) =					831.28	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					9.14	(384)
EI rating (section 14)						91.81	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Matthew Stainrod	**Stroma Number:**	STRO023501
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: 06-18-69419 House-11

Address : House-11, Bertram Street, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	67.15	(1a)	x	2.4	(2a)	=	161.16	(3a)
First floor	61.15	(1b)	x	2.47	(2b)	=	151.04	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	128.3	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	312.2	(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) =	0.13	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.28	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.26	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.33	0.32	0.32	0.28	0.28	0.24	0.24	0.24	0.26	0.28	0.29	0.3

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=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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			2.1	x	1.4	=	2.94			(26)
Windows Type 1			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 2			11.61	x1/[1/(1.4)+ 0.04]		=	15.39			(27)
Rooflights Type 1			4.05	x1/[1/(1.4) + 0.04]		=	5.67			(27b)
Rooflights Type 2			5.4	x1/[1/(1.4) + 0.04]		=	7.56			(27b)
Floor			67.15	x	0.13	=	8.7295	110	7386.5	(28)
Walls	104.64	16.59	88.05	x	0.15	=	13.21	150	13207.5	(29)
Roof Type1	40.31	0	40.31	x	0.11	=	4.43	9	362.79	(30)
Roof Type2	30.99	9.45	21.54	x	0.11	=	2.37	9	193.86	(30)
Total area of elements, m²			243.09							(31)
Party wall			39.55	x	0	=	0	70	2768.5	(32)
Internal wall **			216					9	1944	(32c)
Internal floor			61.15					18	1100.7	(32d)
Internal ceiling			61.15					9	550.35	(32e)

** 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) = 63.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27514.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 214.45 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

DER WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 19.78 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 83.19 | (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=	57.06	56.84	56.63	55.64	55.45	54.59	54.59	54.43	54.92	55.45	55.83	56.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	140.25	140.03	139.82	138.83	138.65	137.78	137.78	137.62	138.12	138.65	139.02	139.41	

Average = $Sum(39)_{1...12}$ /12= | 138.83 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.09	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.08	1.08	1.08	1.09	

Average = $Sum(40)_{1...12}$ /12= | 1.08 | (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 | 2.89 | (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 | 102.85 | (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=	113.13	109.02	104.91	100.79	96.68	92.56	92.56	96.68	100.79	104.91	109.02	113.13	

Total = $Sum(44)_{1...12}$ = | 1234.18 | (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=	167.77	146.74	151.42	132.01	126.67	109.3	101.29	116.23	117.61	137.07	149.62	162.48	

Total = $Sum(45)_{1...12}$ = | 1618.2 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.17	22.01	22.71	19.8	19	16.4	15.19	17.43	17.64	20.56	22.44	24.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.96	49.32	49.27	45.65	47.17	49.27	49.32	50.96	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=	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44	(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=	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44	

Output from water heater (annual)$_{1...12}$ — 2207.36 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	68.52	60.3	63.09	56.22	54.43	47.76	45.47	50.96	51.44	58.32	62.08	66.76	(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=	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	144.52	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	26.52	23.56	19.16	14.5	10.84	9.15	9.89	12.86	17.25	21.91	25.57	27.26	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	295.66	298.73	291	274.54	253.76	234.23	221.19	218.12	225.85	242.31	263.09	282.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	37.45	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	-115.62	(71)
Water heating gains (Table 5)													
(72)m=	92.1	89.73	84.79	78.09	73.16	66.33	61.12	68.5	71.44	78.38	86.22	89.74	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	483.64	481.37	464.3	436.48	407.12	379.07	361.55	368.83	383.9	411.96	444.23	468.97	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	2.88	x	19.64	x	0.76	x	0.7	=	20.85	(76)
East	0.9x	1	x	2.88	x	38.42	x	0.76	x	0.7	=	40.79	(76)
East	0.9x	1	x	2.88	x	63.27	x	0.76	x	0.7	=	67.18	(76)
East	0.9x	1	x	2.88	x	92.28	x	0.76	x	0.7	=	97.98	(76)
East	0.9x	1	x	2.88	x	113.09	x	0.76	x	0.7	=	120.08	(76)
East	0.9x	1	x	2.88	x	115.77	x	0.76	x	0.7	=	122.92	(76)
East	0.9x	1	x	2.88	x	110.22	x	0.76	x	0.7	=	117.03	(76)
East	0.9x	1	x	2.88	x	94.68	x	0.76	x	0.7	=	100.53	(76)
East	0.9x	1	x	2.88	x	73.59	x	0.76	x	0.7	=	78.14	(76)
East	0.9x	1	x	2.88	x	45.59	x	0.76	x	0.7	=	48.41	(76)
East	0.9x	1	x	2.88	x	24.49	x	0.76	x	0.7	=	26	(76)
East	0.9x	1	x	2.88	x	16.15	x	0.76	x	0.7	=	17.15	(76)
West	0.9x	0.77	x	11.61	x	19.64	x	0.76	x	0.7	=	84.07	(80)
West	0.9x	0.77	x	11.61	x	38.42	x	0.76	x	0.7	=	164.45	(80)
West	0.9x	0.77	x	11.61	x	63.27	x	0.76	x	0.7	=	270.83	(80)
West	0.9x	0.77	x	11.61	x	92.28	x	0.76	x	0.7	=	394.99	(80)
West	0.9x	0.77	x	11.61	x	113.09	x	0.76	x	0.7	=	484.07	(80)
West	0.9x	0.77	x	11.61	x	115.77	x	0.76	x	0.7	=	495.54	(80)
West	0.9x	0.77	x	11.61	x	110.22	x	0.76	x	0.7	=	471.77	(80)
West	0.9x	0.77	x	11.61	x	94.68	x	0.76	x	0.7	=	405.24	(80)
West	0.9x	0.77	x	11.61	x	73.59	x	0.76	x	0.7	=	314.99	(80)
West	0.9x	0.77	x	11.61	x	45.59	x	0.76	x	0.7	=	195.14	(80)
West	0.9x	0.77	x	11.61	x	24.49	x	0.76	x	0.7	=	104.82	(80)
West	0.9x	0.77	x	11.61	x	16.15	x	0.76	x	0.7	=	69.13	(80)
Rooflights	0.9x	1	x	4.05	x	26.61	x	0.76	x	0.7	=	51.6	(82)
Rooflights	0.9x	1	x	5.4	x	26.61	x	0.76	x	0.7	=	68.79	(82)
Rooflights	0.9x	1	x	4.05	x	53.79	x	0.76	x	0.7	=	104.31	(82)
Rooflights	0.9x	1	x	5.4	x	53.79	x	0.76	x	0.7	=	139.08	(82)
Rooflights	0.9x	1	x	4.05	x	92.95	x	0.76	x	0.7	=	180.24	(82)
Rooflights	0.9x	1	x	5.4	x	92.95	x	0.76	x	0.7	=	240.31	(82)
Rooflights	0.9x	1	x	4.05	x	142.44	x	0.76	x	0.7	=	276.21	(82)
Rooflights	0.9x	1	x	5.4	x	142.44	x	0.76	x	0.7	=	368.28	(82)
Rooflights	0.9x	1	x	4.05	x	180.71	x	0.76	x	0.7	=	350.43	(82)
Rooflights	0.9x	1	x	5.4	x	180.71	x	0.76	x	0.7	=	467.24	(82)
Rooflights	0.9x	1	x	4.05	x	187.72	x	0.76	x	0.7	=	364.02	(82)
Rooflights	0.9x	1	x	5.4	x	187.72	x	0.76	x	0.7	=	485.36	(82)
Rooflights	0.9x	1	x	4.05	x	177.6	x	0.76	x	0.7	=	344.39	(82)
Rooflights	0.9x	1	x	5.4	x	177.6	x	0.76	x	0.7	=	459.18	(82)
Rooflights	0.9x	1	x	4.05	x	148.43	x	0.76	x	0.7	=	287.83	(82)

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Rooflights 0.9x	1	x	5.4	x	148.43	x	0.76	x	0.7	=	383.77	(82)
Rooflights 0.9x	1	x	4.05	x	110.34	x	0.76	x	0.7	=	213.96	(82)
Rooflights 0.9x	1	x	5.4	x	110.34	x	0.76	x	0.7	=	285.28	(82)
Rooflights 0.9x	1	x	4.05	x	64.97	x	0.76	x	0.7	=	125.99	(82)
Rooflights 0.9x	1	x	5.4	x	64.97	x	0.76	x	0.7	=	167.99	(82)
Rooflights 0.9x	1	x	4.05	x	33.49	x	0.76	x	0.7	=	64.94	(82)
Rooflights 0.9x	1	x	5.4	x	33.49	x	0.76	x	0.7	=	86.58	(82)
Rooflights 0.9x	1	x	4.05	x	21.68	x	0.76	x	0.7	=	42.04	(82)
Rooflights 0.9x	1	x	5.4	x	21.68	x	0.76	x	0.7	=	56.06	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	225.31	448.64	758.56	1137.47	1421.82	1467.84	1392.37	1177.37	892.36	537.52	282.35	184.38	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	708.95	930	1222.87	1573.95	1828.94	1846.91	1753.92	1546.2	1276.26	949.48	726.58	653.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.85	0.66	0.47	0.34	0.41	0.69	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.89	20.29	20.71	20.93	20.99	21	21	20.94	20.55	19.99	19.59	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.01	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.95	0.82	0.6	0.4	0.27	0.32	0.61	0.93	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.76	19.01	19.4	19.8	19.97	20.02	20.02	20.02	19.99	19.66	19.12	18.71	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.23	19.63	20.03	20.22	20.26	20.27	20.27	20.23	19.89	19.34	18.94	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.83	19.08	19.48	19.88	20.07	20.11	20.12	20.12	20.08	19.74	19.19	18.79	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.98	0.94	0.81	0.6	0.41	0.28	0.33	0.61	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	705.47	915.15	1151.36	1275.34	1105.37	752.93	484.3	510.14	784.54	872.75	718.26	651.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2038.12	1986.09	1814.52	1524.66	1159.98	759.87	485.14	512.04	825.88	1266.75	1680.54	2033.72	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	991.49	719.67	493.39	179.51	40.63	0	0	0	0	293.14	692.84	1028.67

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 4439.33 (98)

Space heating requirement in kWh/m²/year 34.6 (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 91.8 (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)	991.49	719.67	493.39	179.51	40.63	0	0	0	0	293.14	692.84	1028.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1080.05	783.96	537.46	195.54	44.26	0	0	0	0	319.32	754.73	1120.56	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 4835.87 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =$Sum(215)_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	218.73	192.76	202.38	181.32	175.93	154.95	148.45	165.49	166.93	188.03	198.94	213.44

Efficiency of water heater 82.5 (216)

(217)m=	89.97	89.66	88.89	86.88	84.1	82.5	82.5	82.5	82.5	87.93	89.55	90.06	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	243.12	214.98	227.68	208.71	209.2	187.82	179.95	200.6	202.34	213.85	222.16	237.01

Total = $Sum(219a)_{1...12}$ = 2547.4 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4835.87	
Water heating fuel used		2547.4	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		30	(231)
Electricity for lighting		468.38	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	1044.55	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	550.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1594.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	243.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		1853.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.45	(273)
EI rating (section 14)				86	(274)

APPENDIX C1

COMMUNITY CENTRE – PART L RESULTS

"LEAN"

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Highgate Newtown Community Centre

As designed

Date: Fri Nov 02 12:08:03 2018

Administrative information

Building Details

Address: 25 Bertram Street, Camden, London, N19 5DQ

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.3

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	14.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	14
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.24	2.2	Damper 1.50 (internal)-frame
Floor	0.25	0.19	0.24	Exposed Floor
Roof	0.25	0.15	0.15	Roof
Windows***, roof windows, and rooflights	2.2	1.59	1.74	0F Hallf Rooflights
Personnel doors	2.2	1.63	1.63	Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- 3

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- 1 (0F Gym)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.6	-	1.6	0.7
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

3- 4 (0F Kitchen)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.6	0.7
Standard value	N/A	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- 5 (0F Servery)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	1.6	0.7
Standard value	0.91*	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- 6 (0F Laundrette)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.6	0.7
Standard value	N/A	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

6- 8

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

7- 13 (3F RecBooth)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.6	-	1.6	0.7
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82. ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

8- WC (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0F WC1	0.3	-	-	-	-	-	-	-	-	-	N/A
0F WC2	0.3	-	-	-	-	-	-	-	-	-	N/A
1F WC	0.3	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
2F WC	0.3	-	-	-	-	-	-	-	-	-	N/A
3F WC1	0.3	-	-	-	-	-	-	-	-	-	N/A
3F WC2	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
0F Gym	-	80	-	364
0F Hall	-	80	-	1656
0F CafeSeating	-	80	22	344
0F Kitchen	-	80	-	224
0F Servery	-	80	-	44
0F SeatingArea	-	80	22	215
0F ActivitySpace	80	-	-	521
0F Laundrette	80	-	-	38
1F Meeting	80	-	-	287
1F Office (B.1.02)	80	-	-	227
1F Circulation	-	80	-	76
2F Activity Room	80	-	-	340
2F ArtistResidence	-	80	-	50
2F Circulation1	-	80	-	158
2F Pottery	80	-	-	566
2F Art	80	-	-	607
3F Activity	80	-	-	508
3F Circulation	-	80	-	201
3F 1to1_1	80	-	-	115
3F 1to1_2	80	-	-	119
3F RecBooth	80	-	-	136
0F Store1	80	-	-	7
0F WC1	-	80	-	103
0F WC2	-	80	-	99
1F WC	-	80	-	67
2F WC	-	80	-	68
3F WC1	-	80	-	61
3F WC2	-	80	-	45
0F Stairs 1	-	80	-	38
1F Stairs 1	-	80	-	83
2F Stairs 1	-	80	-	160
3F Stairs 1	-	80	-	157
0F WC circulation	-	80	-	35
1F Stairs 2	-	80	-	36
2F Office (Police room)	80	-	-	245
3F Store1	80	-	-	13

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
0F Circulation2	-	80	-	35
0F Stairs 2	-	80	-	34
3F JuiceBar	-	80	-	109
0F Lift	-	80	-	18
0F CIrculation 3	-	80	-	17
0F Store2	80	-	-	46
0F Office (B.0.01)	80	-	-	92
1F Workshop	80	-	-	587
1F WorkshopStrg	80	-	-	59
1F SeatingArea	-	80	-	73
3F Store2	80	-	-	15
3F Office	80	-	-	275
3F SeatingArea	-	80	22	188

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0F Gym	NO (-55%)	NO
0F Hall	NO (-91%)	NO
0F CafeSeating	NO (-2%)	NO
0F Servery	NO (-79%)	NO
0F SeatingArea	NO (-94%)	NO
0F ActivitySpace	NO (-82%)	NO
1F Meeting	NO (-38%)	NO
1F Office (B.1.02)	NO (-59%)	NO
2F Activity Room	NO (-69%)	NO
2F Pottery	NO (-68%)	NO
2F Art	NO (-46%)	NO
3F Activity	NO (-53%)	NO
3F 1to1_1	NO (-57%)	NO
3F 1to1_2	NO (-47%)	NO
3F RecBooth	N/A	N/A
2F Office (Police room)	NO (-41%)	NO
3F JuiceBar	NO (-89%)	NO
0F Office (B.0.01)	NO (-92%)	NO
1F Workshop	NO (-37%)	NO
1F SeatingArea	NO (-88%)	NO
3F Office	NO (-56%)	NO
3F SeatingArea	NO (-31%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1612	1612
External area [m^2]	5988	5988
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	1493	1834
Average U-value [W/m^2K]	0.25	0.31
Alpha value* [%]	10.64	10.64

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	12.8	15
Cooling	0.03	0.08
Auxiliary	1.04	0.92
Lighting	15.6	16.62
Hot water	12.14	12.36
Equipment*	14.18	14.18
TOTAL**	**41.61**	**44.99**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	44.5	48.17
Primary energy* [kWh/m^2]	81.59	86.13
Total emissions [kg/m^2]	14	14.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	46	0	14	0	1	0.91	0	0.91	0
	Notional	50	0	16.7	0	0.7	0.83	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	6.8	1.1	2.1	0.1	2.1	0.91	3.6	0.91	3.6
	Notional	11.4	2.8	3.9	0.2	1.2	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	9.1	0	0	0	0
	Notional	0	0	0	0	6.5	0	0	----	----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	775.9	0	236.9	0	7.7	0.91	0	0.91	0
	Notional	682.7	0	231.5	0	16.4	0.82	0	----	----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	98.2	0	30	0	1	0.91	0	0.91	0
	Notional	112.7	0	38.2	0	1	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	29	47.8	8.8	3.7	5.6	0.91	3.6	0.91	3.6
	Notional	45.1	151.7	15.3	11.7	3.2	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	47.9	0	14.6	0	4.2	0.91	0	0.91	0
	Notional	56.5	0	19.2	0	5.2	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**U_{i-Typ}**	**U_{i-Min}**	**Surface where the minimum value occurs***
Wall	0.23	0.22	External Wall
Floor	0.2	0.19	Ground Floor
Roof	0.15	0.15	Roof
Windows, roof windows, and rooflights	1.5	1.56	1.5x1 Unopened (H elevation - 44% 5.84m2 openable)
Personnel doors	1.5	1.63	Door
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project
U_{i-Typ} = Typical individual element U-values [W/(m²K)]			U_{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	3

APPENDIX C2

COMMUNITY CENTRE – PART L RESULTS

"CLEAN"

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Highgate Newtown Community Centre

As designed

Date: Fri Nov 02 13:29:41 2018

Administrative information

Building Details

Address: 25 Bertram Street, Camden, London, N19 5DQ

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.3

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	14.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	11.8
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.24	2.2	Damper 1.50 (internal)-frame
Floor	0.25	0.19	0.24	Exposed Floor
Roof	0.25	0.15	0.15	Roof
Windows***, roof windows, and rooflights	2.2	1.59	1.74	0F Hallf Rooflights
Personnel doors	2.2	1.63	1.63	Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- 3

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.86	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- 1 (0F Gym)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.86	3.6	-	1.6	0.7
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

3- 4 (0F Kitchen)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0	-	-	1.6	0.7
Standard value	N/A	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- 5 (0F Servery)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.86	-	-	1.6	0.7
Standard value	0.91*	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- 6 (0F Laundrette)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0	-	-	1.6	0.7
Standard value	N/A	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

6- 8

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

7- 13 (3F RecBooth)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	3.6	-	1.6	0.7
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

8- WC (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

1- CHP + back up boilers

	CHPQA quality index	CHP electrical efficiency
This building	152	0.36
Standard value	105	0.2

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0F WC1	0.3	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0F WC2	0.3	-	-	-	-	-	-	-	-	-	N/A
1F WC	0.3	-	-	-	-	-	-	-	-	-	N/A
2F WC	0.3	-	-	-	-	-	-	-	-	-	N/A
3F WC1	0.3	-	-	-	-	-	-	-	-	-	N/A
3F WC2	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0F Gym	-	80	-	364
0F Hall	-	80	-	1656
0F CafeSeating	-	80	22	344
0F Kitchen	-	80	-	224
0F Servery	-	80	-	44
0F SeatingArea	-	80	22	215
0F ActivitySpace	80	-	-	521
0F Laundrette	80	-	-	38
1F Meeting	80	-	-	287
1F Office (B.1.02)	80	-	-	227
1F Circulation	-	80	-	76
2F Activity Room	80	-	-	340
2F ArtistResidence	-	80	-	50
2F Circulation1	-	80	-	158
2F Pottery	80	-	-	566
2F Art	80	-	-	607
3F Activity	80	-	-	508
3F Circulation	-	80	-	201
3F 1to1_1	80	-	-	115
3F 1to1_2	80	-	-	119
3F RecBooth	80	-	-	136
0F Store1	80	-	-	7
0F WC1	-	80	-	103
0F WC2	-	80	-	99
1F WC	-	80	-	67
2F WC	-	80	-	68
3F WC1	-	80	-	61
3F WC2	-	80	-	45
0F Stairs 1	-	80	-	38
1F Stairs 1	-	80	-	83
2F Stairs 1	-	80	-	160
3F Stairs 1	-	80	-	157
0F WC circulation	-	80	-	35
1F Stairs 2	-	80	-	36

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
2F Office (Police room)	80	-	-	245
3F Store1	80	-	-	13
0F Circulation2	-	80	-	35
0F Stairs 2	-	80	-	34
3F JuiceBar	-	80	-	109
0F Lift	-	80	-	18
0F CIrculation 3	-	80	-	17
0F Store2	80	-	-	46
0F Office (B.0.01)	80	-	-	92
1F Workshop	80	-	-	587
1F WorkshopStrg	80	-	-	59
1F SeatingArea	-	80	-	73
3F Store2	80	-	-	15
3F Office	80	-	-	275
3F SeatingArea	-	80	22	188

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0F Gym	NO (-55%)	NO
0F Hall	NO (-91%)	NO
0F CafeSeating	NO (-2%)	NO
0F Servery	NO (-79%)	NO
0F SeatingArea	NO (-94%)	NO
0F ActivitySpace	NO (-82%)	NO
1F Meeting	NO (-38%)	NO
1F Office (B.1.02)	NO (-59%)	NO
2F Activity Room	NO (-69%)	NO
2F Pottery	NO (-68%)	NO
2F Art	NO (-46%)	NO
3F Activity	NO (-53%)	NO
3F 1to1_1	NO (-57%)	NO
3F 1to1_2	NO (-47%)	NO
3F RecBooth	N/A	N/A
2F Office (Police room)	NO (-41%)	NO
3F JuiceBar	NO (-89%)	NO
0F Office (B.0.01)	NO (-92%)	NO
1F Workshop	NO (-37%)	NO
1F SeatingArea	NO (-88%)	NO
3F Office	NO (-56%)	NO
3F SeatingArea	NO (-31%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1612	1612
External area [m^2]	5988	5988
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	1493	1834
Average U-value [W/m^2K]	0.25	0.31
Alpha value* [%]	10.64	10.64

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	13.48	15
Cooling	0.03	0.08
Auxiliary	1.04	0.92
Lighting	15.6	16.62
Hot water	19.79	12.36
Equipment*	14.18	14.18
TOTAL**	**42.21**	**44.99**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	7.72	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	44.5	48.17
Primary energy* [kWh/m^2]	68.03	86.13
Total emissions [kg/m^2]	11.8	14.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	46	0	14.8	0	1	0.86	0	0.86	0
Notional	50	0	16.7	0	0.7	0.83	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	6.8	1.1	2.2	0.1	2.1	0.86	3.6	0.86	3.6
Notional	11.4	2.8	3.9	0.2	1.2	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	0	0	0	0	9.1	0	0	0	0
Notional	0	0	0	0	6.5	0	0	----	----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	775.9	0	249.4	0	7.7	0.86	0	0.86	0
Notional	682.7	0	231.5	0	16.4	0.82	0	----	----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	98.2	0	31.6	0	1	0.86	0	0.86	0
Notional	112.7	0	38.2	0	1	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	29	47.8	9.3	3.7	5.6	0.86	3.6	0.86	3.6
Notional	45.1	151.7	15.3	11.7	3.2	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	47.9	0	15.4	0	4.2	0.86	0	0.86	0
Notional	56.5	0	19.2	0	5.2	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.22	External Wall
Floor	0.2	0.19	Ground Floor
Roof	0.15	0.15	Roof
Windows, roof windows, and rooflights	1.5	1.56	1.5x1 Unopened (H elevation - 44% 5.84m2 openable)
Personnel doors	1.5	1.63	Door
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

APPENDIX C3

COMMUNITY CENTRE – PART L RESULTS

“GREEN”

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Highgate Newtown Community Centre

As designed

Date: Fri Nov 02 14:20:38 2018

Administrative information

Building Details

Address: 25 Bertram Street, Camden, London, N19 5DQ

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.3

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	14.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	10.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.24	2.2	Damper 1.50 (internal)-frame
Floor	0.25	0.19	0.24	Exposed Floor
Roof	0.25	0.15	0.15	Roof
Windows***, roof windows, and rooflights	2.2	1.59	1.74	0F Hallf Rooflights
Personnel doors	2.2	1.63	1.63	Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- 3

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- 1 (0F Gym)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	3.6	-	1.6	0.7
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

3- 4 (0F Kitchen)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.6	0.7
Standard value	N/A	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- 5 (0F Servery)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	-	1.6	0.7
Standard value	0.91*	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- 6 (0F Laundrette)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	-	-	1.6	0.7
Standard value	N/A	N/A	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

6- 8

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

7- 13 (3F RecBooth)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	3.6	-	1.6	0.7
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82. ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

8- WC (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

1- CHP + back up boilers

	CHPQA quality index	CHP electrical efficiency
This building	152	0.36
Standard value	105	0.2

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0F WC1	0.3	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
0F WC2	0.3	-	-	-	-	-	-	-	-	-	N/A
1F WC	0.3	-	-	-	-	-	-	-	-	-	N/A
2F WC	0.3	-	-	-	-	-	-	-	-	-	N/A
3F WC1	0.3	-	-	-	-	-	-	-	-	-	N/A
3F WC2	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
0F Gym	-	80	-	364
0F Hall	-	80	-	1656
0F CafeSeating	-	80	22	344
0F Kitchen	-	80	-	224
0F Servery	-	80	-	44
0F SeatingArea	-	80	22	215
0F ActivitySpace	80	-	-	521
0F Laundrette	80	-	-	38
1F Meeting	80	-	-	287
1F Office (B.1.02)	80	-	-	227
1F Circulation	-	80	-	76
2F Activity Room	80	-	-	340
2F ArtistResidence	-	80	-	50
2F Circulation1	-	80	-	158
2F Pottery	80	-	-	566
2F Art	80	-	-	607
3F Activity	80	-	-	508
3F Circulation	-	80	-	201
3F 1to1_1	80	-	-	115
3F 1to1_2	80	-	-	119
3F RecBooth	80	-	-	136
0F Store1	80	-	-	7
0F WC1	-	80	-	103
0F WC2	-	80	-	99
1F WC	-	80	-	67
2F WC	-	80	-	68
3F WC1	-	80	-	61
3F WC2	-	80	-	45
0F Stairs 1	-	80	-	38
1F Stairs 1	-	80	-	83
2F Stairs 1	-	80	-	160
3F Stairs 1	-	80	-	157
0F WC circulation	-	80	-	35
1F Stairs 2	-	80	-	36

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
2F Office (Police room)	80	-	-	245
3F Store1	80	-	-	13
0F Circulation2	-	80	-	35
0F Stairs 2	-	80	-	34
3F JuiceBar	-	80	-	109
0F Lift	-	80	-	18
0F CIrculation 3	-	80	-	17
0F Store2	80	-	-	46
0F Office (B.0.01)	80	-	-	92
1F Workshop	80	-	-	587
1F WorkshopStrg	80	-	-	59
1F SeatingArea	-	80	-	73
3F Store2	80	-	-	15
3F Office	80	-	-	275
3F SeatingArea	-	80	22	188

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0F Gym	NO (-55%)	NO
0F Hall	NO (-91%)	NO
0F CafeSeating	NO (-2%)	NO
0F Servery	NO (-79%)	NO
0F SeatingArea	NO (-94%)	NO
0F ActivitySpace	NO (-82%)	NO
1F Meeting	NO (-38%)	NO
1F Office (B.1.02)	NO (-59%)	NO
2F Activity Room	NO (-69%)	NO
2F Pottery	NO (-68%)	NO
2F Art	NO (-46%)	NO
3F Activity	NO (-53%)	NO
3F 1to1_1	NO (-57%)	NO
3F 1to1_2	NO (-47%)	NO
3F RecBooth	N/A	N/A
2F Office (Police room)	NO (-41%)	NO
3F JuiceBar	NO (-89%)	NO
0F Office (B.0.01)	NO (-92%)	NO
1F Workshop	NO (-37%)	NO
1F SeatingArea	NO (-88%)	NO
3F Office	NO (-56%)	NO
3F SeatingArea	NO (-31%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1612	1612
External area [m^2]	5988	5988
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	1493	1834
Average U-value [W/m^{2}K]	0.25	0.31
Alpha value* [%]	10.64	10.64

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	13.48	15
Cooling	0.03	0.08
Auxiliary	1.04	0.92
Lighting	15.6	16.62
Hot water	19.79	12.36
Equipment*	14.18	14.18
TOTAL**	**42.21**	**44.99**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	3.19	0
Wind turbines	0	0
CHP generators	7.72	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	44.5	48.17
Primary energy* [kWh/m^2]	68.03	86.13
Total emissions [kg/m^2]	10.2	14.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	46	0	14.8	0	1	0.86	0	0.86	0
	Notional	50	0	16.7	0	0.7	0.83	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	6.8	1.1	2.2	0.1	2.1	0.86	3.6	0.86	3.6
	Notional	11.4	2.8	3.9	0.2	1.2	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	9.1	0	0	0	0
	Notional	0	0	0	0	6.5	0	0	----	----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	775.9	0	249.4	0	7.7	0.86	0	0.86	0
	Notional	682.7	0	231.5	0	16.4	0.82	0	----	----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	98.2	0	31.6	0	1	0.86	0	0.86	0
	Notional	112.7	0	38.2	0	1	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	29	47.8	9.3	3.7	5.6	0.86	3.6	0.86	3.6
	Notional	45.1	151.7	15.3	11.7	3.2	0.82	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	47.9	0	15.4	0	4.2	0.86	0	0.86	0
	Notional	56.5	0	19.2	0	5.2	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.22	External Wall
Floor	0.2	0.19	Ground Floor
Roof	0.15	0.15	Roof
Windows, roof windows, and rooflights	1.5	1.56	1.5x1 Unopened (H elevation - 44% 5.84m2 openable)
Personnel doors	1.5	1.63	Door
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	3