MLM

Energy Statement

For

Heath House
London

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Project Revision Sheet

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Contents **Page**

Appendices

1 Introduction

MLM were commissioned to undertake an energy assessment to support the Planning Application for the conversion of the Heath House property, London.

The development is refurbishment of the existing listed Grade II property into six apartments. The proposed development is located within the London Borough of Camden.

The Greater London Authority and the London Borough of Camden are the regional and local bodies that set the Planning Policy context, referencing to National Standards and Regulations.

The proposed development is required by the London Borough of Camden to make carbon emission reductions in accordance with the Camden Core Strategy Policy CS13.

The aim of this report is to assess feasible carbon emissions reductions through the implementation of efficient energy measures, the use of local district system or alternatively the use of an onsite Combine Heat and Power system, and finally the use of zero carbon technologies.

This report demonstrates how the site has followed the London Plan's Energy Hierarchy by reducing energy demand through passive design, energy efficiency measures, generating heat in a clean and efficient system and by using on-site renewable energy systems to further reduce the overall carbon emissions of the development.

The methodology followed in this report follows the guidance set out by the Camden council for developing energy strategies as detailed in the Core Strategy and Policies for Management of Development.

The energy consumption figures for the proposed development are based on SAP modeling data produced under Building Regulations Part L1B 2013 software compliant.

The proposed Sustainability Principles and engineering concepts will also incorporate the Requirements and Guidelines of the relevant British Standards, CIBSE Guides and DfE Building Bulletins.

2 Executive Summary

The proposed development will implement significant energy efficiency measures where feasible, a new heating and hot water service and new lighting system to achieve the required carbon emission reductions by the Local Authority and the London Plan.

The strategy detailed within this report follows the Greater London Authority's Energy Hierarchy and achieves a 45.71% improvement in CO_2 emissions over the baseline.

The carbon emissions baseline for the scheme has been identified at 64,756 kg CO_2/yr for space heating, domestic hot water, lighting and auxiliary (regulated emissions). To ensure Compliance with the Planning Requirements, the scheme needs to reduce its carbon emission by 29.602kgCO_2/yr.

The following strategy has been implemented site wide:

- 'Be Lean' : Energy efficiency measures to improve the building fabric and services: high performance U-Values (0.17 for the basement floor, 0.15 for basement walls, 0.20 for the new walls, 0.15 for roofs, 0.20 for the exposed flor, 0.00 for partition walls and 1.5 for new windows (double glazed) in W/m^{2}K).

- 'Be Clean': a CHP has not been deemed feasible for the scheme.

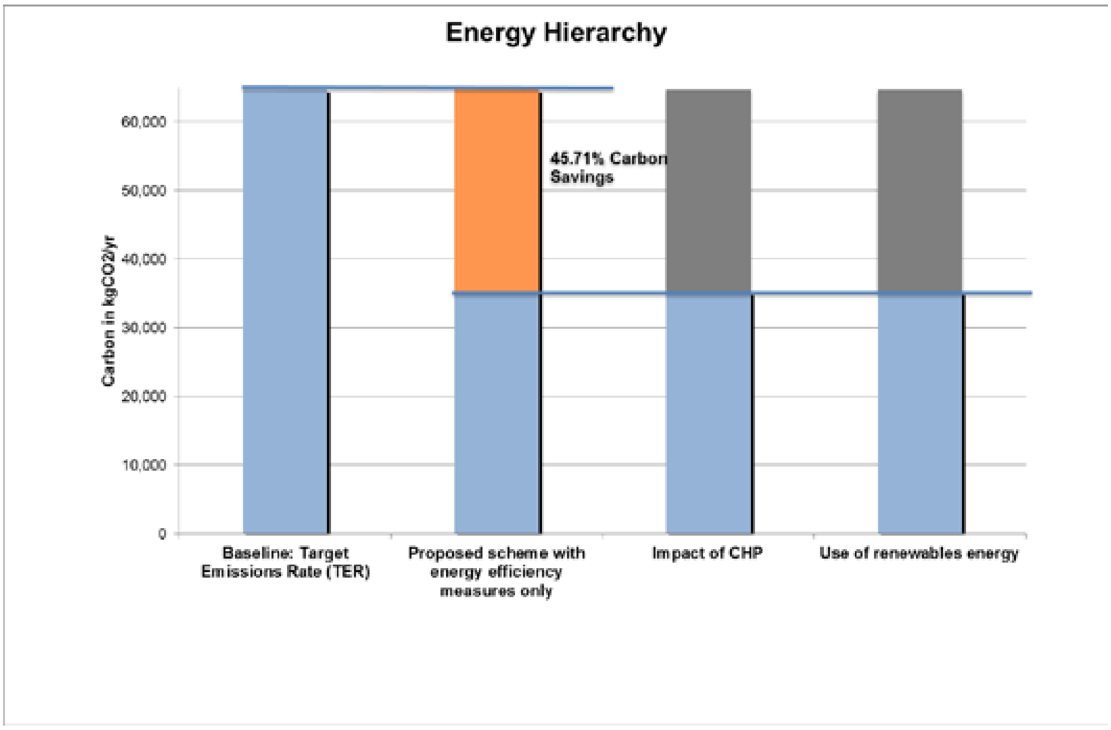
- 'Be Green': The proposed development is a Grade II listed property located within the conservation area of Hampstead, sub area 7 Whitestone Pond. All zero carbon technologies have been assessed within this report, and due to site constraints the use of zero carbon technologies has not been deemed feasible for the scheme.

The energy efficiency measures included within this report represent current best practice and the use of a low and zero carbon technology.

The conclusions of the assessment can be summarised by the following table:

	Carbon Dioxide Emissions (Tonnes/ Annum)	CO_2 Emissions Reduction (%)
Baseline	64.77	-
Savings from Energy Demand Reduction	29.60	45.71%
Savings from CHP	-	-
Savings from Renewable Energy	-	-
Total Target Savings	22.67	35%

The following graph illustrates the carbon savings for each stage of the Greater London Authority's Energy Hierarchy against the previous stage.



3 Planning Requirement

This energy strategy has been designed to adhere to the national, Regional and Local Policies. The proposed development is located within the Greater London area and is therefore requested to implement the London Plan Energy Hierarchy from GLA Energy Team Guidance on Planning Energy Assessments, Version 1, 2011, with further alterations to the London Plan April 2015.

Baseline Model Section 5.1

The proposed development is a refurbishment; therefore, a baseline has been created using the SAP Appendix S data. The baseline then was taken from the created Dwelling Emission Rate (DER) worksheet of the SAP Models.

'Be Lean' Section 5.2:

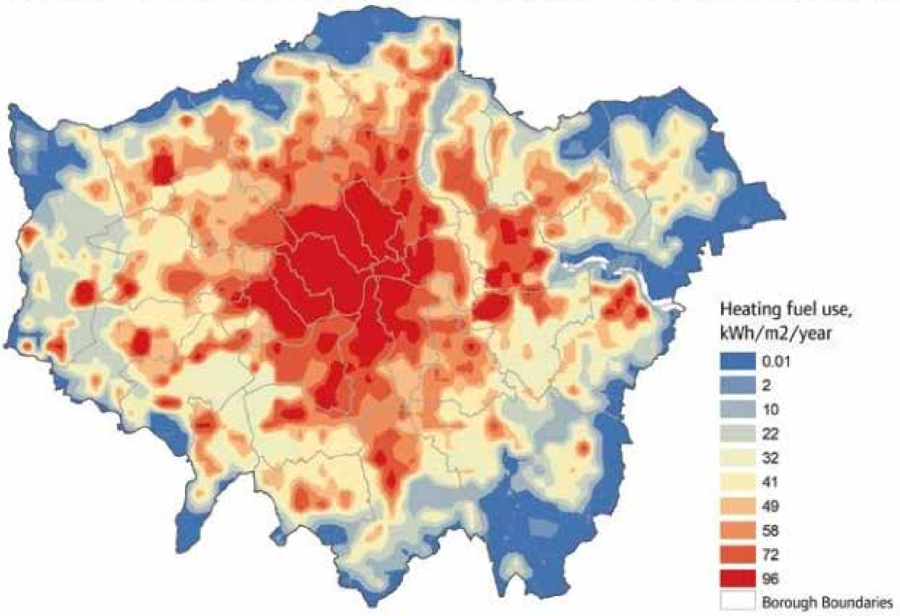
Implementation of energy efficient ('Be Lean') measures specific to the scheme is encouraged at the earliest design stage of a development and aims to reduce the energy demand. Measures typically include passive design: both Architectural and building fabric measures, and active design: energy efficient services. It is possible to exceed Building Regulations Requirements (Part L 2013) through reduced energy demand ('Be Lean') measures alone.

'Be Clean' Section 5.5 and 5.6

Decentralised Energy Networks Section 5.5

The GLA require developers to prioritise connection to existing or planned decentralised energy networks where feasible. The London heat map below has been developed to help developers identify decentralised energy opportunities in London.

Map 5.1 Heat density in London (relative heat demand based on fuel use kWh/m2/year)



Source: Centre for Sustainable Energy. © Crown copyright. All rights reserved. Greater London Authority 100032379 (2009)

Decentralised Energy in Development Proposals Section 5.6

The use of the 'clean' energy supply refers to the energy efficiency of heating, cooling and power systems. Planning applications should demonstrate how the heating, cooling and power systems have been selected to minimise carbon emissions in accordance with the following hierarchy (Policy 5.6):

A. The proposed development should evaluate the feasibility of the use of combined heat and power (CHP) systems. Where a new CHP system is appropriate, opportunities to extend the system beyond the site boundary to adjacent sites should be examined.

B. Major developments should select energy systems in accordance with the following hierarchy:

   a. Connection to existing heating or cooling networks
   b. Site wide CHP network
   c. Communal heating and cooling

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the above London heat map. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Cooling

Where design measures and the use of natural and/or mechanical ventilation will not guarantee occupant comfort, a cooling strategy should be specified.

Where appropriate, the cooling strategy should investigate opportunities to improve efficiency through the use of locally available sources such as ground cooling, river/dock water cooling.

'Be Green' Section

The use of renewable energy in developments is encouraged at the 'Be Green' stage. Each renewable energy technology in Policy 5.7 of the London Plan are technically feasible in London and each should be considered in the Energy Statement.

All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets.

Figure 2 provides a graphical representation of the London Plan Energy Hierarchy.

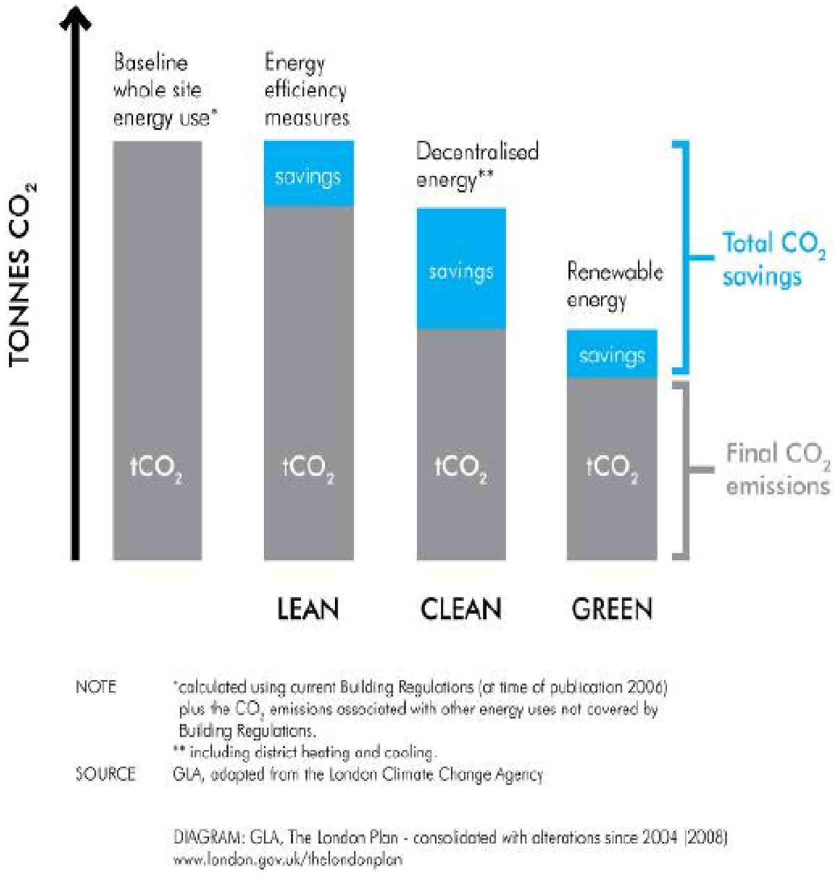


Figure 2 - Energy Hierarchy Diagram, London Plan

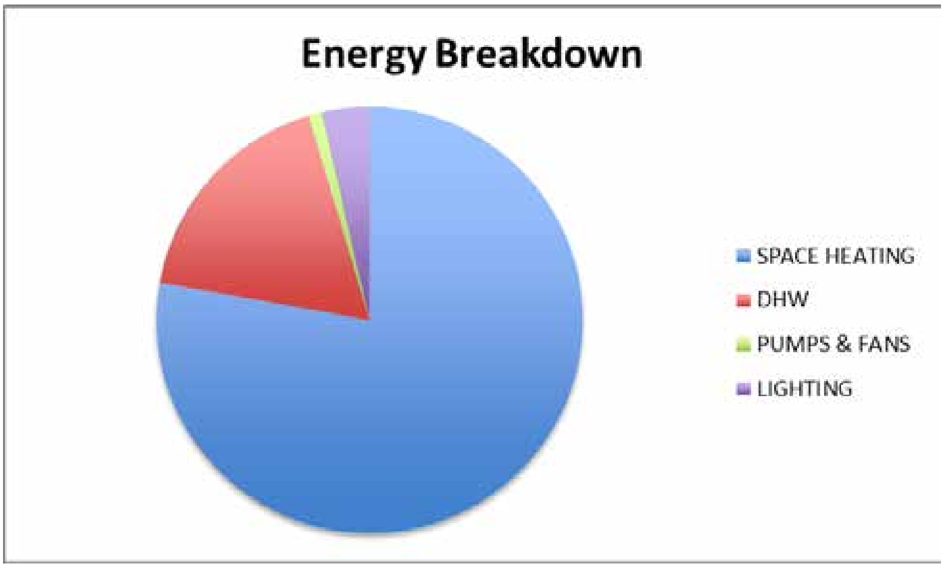
Figure 2 - Energy hierarchy calculation of energy/carbon dioxide savings

4 Baseline Energy Consumption and CO_2 Emissions Figures

Energy modelling has been undertaken to allow the Design Team to explore the performance of the proposed development in terms of the likely energy usage and related carbon emissions. Through this analysis it is possible to identify how to reduce energy use, increase renewable energy capacity, were feasible, and supply energy efficiently. The modelling of the proposed scheme has been undertaken with compliant software to estimate the likely energy demands and carbon emissions of the proposed scheme.

Energy Use	Associated CO_2 Emissions (Tonnes CO_2 / Annum)	Baseline ($KgCO_2 / m^2$. Annum)
Heating	50.39	64.75
Hot Water	11.37	
Auxiliary	0.66	
Lighting	2.34	

The sample Output Documents and Energy Reports can be found in Appendix A.



5 'Be Lean' Stage – Reduction by Energy Efficiency Measures

Specific energy efficient measures have been identified, reviewed and appraised for the proposed scheme.

The measures outlined in this section result in an annual carbon emission saving of 45.71% which equate to 29,602 kgCO_2/yr saved over the baseline.

5.1 Proposed Measures

The following measures are applicable to the dwelling and allow the proposed development to comply with Building Regulation Part L1B 2013.

The energy efficiency measures include:

Passive

The development is predominantly of south/North facing orientation.

Enhanced Building Fabric U-Values

Enhancements of the building fabric will be used.

The table below demonstrates the limiting U-Value set by Approved Document Part L and the proposed U-Value for the development.

Elements	Building Regulations Part L 1B 2013 minimum U-Value (W/m^{2}K)	Proposed U-Value (W/m^{2}K) Indicative build-up
External Walls New	0.28	0.20
Basement Wall	0.28	0.15
Basement Floor	0.25	0.17
Party Walls	0.50	0.00
Roof	0.18	0.15
Ground Floor	0.22	0.20
New Windows (Double Glazing)	1.60	1.50

Ventilation

The dwelling will be fitted with mechanical ventilation within the wet room; all other room will use natural ventilation (trickle vent).

Heating

Space heating is to be supplied from a communal gas fired boiler; each dwellings will be fitted with a hot water cylinder.

Cooling

Cooling will be provided for the proposed development. Each dwelling will be fitted with air conditioning unit with an EEr of no less than 3.5.

Domestic Hot Water

The domestic hot water will be provided by the main system.

Lighting

All lighting will be dedicated low energy fittings.

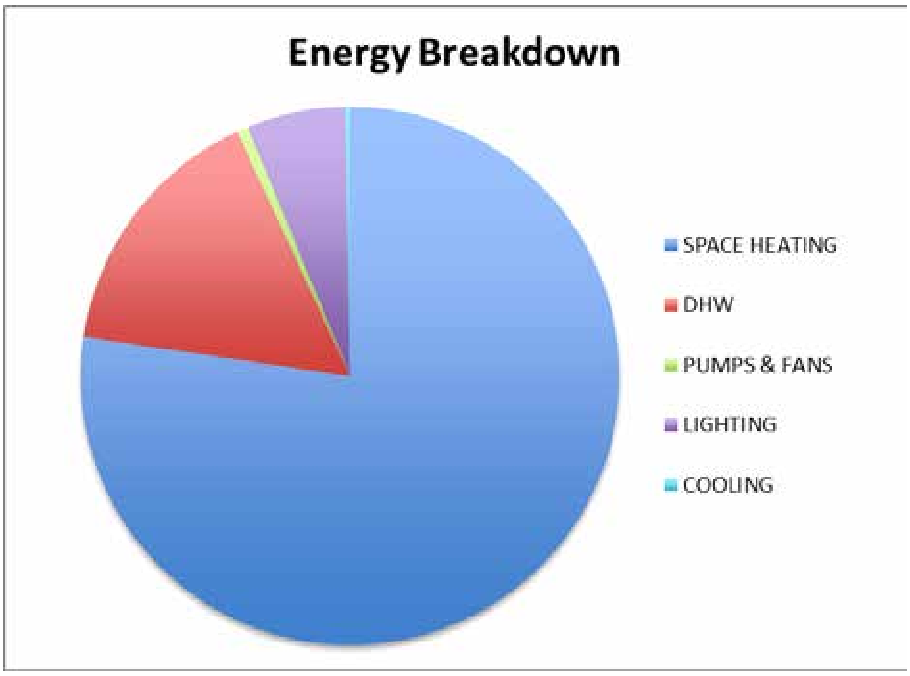
Lighting systems to a number of spaces may include LED technology where viable and subject to the performance of each product being able to deliver to the performance requirements of the space served.

5.2 'Be Lean' Energy Consumption and CO_2 Emission Figures

Based on the aforementioned 'Be Lean' measures, the calculation process has identified the following CO_2 emission figures:

Energy Use	Associated CO_2 Emissions (Tonnes CO_2 / Annum)	BER / DER ($KgCO_2 / m^2$. Annum)
Heating	27.18	35.15
Hot Water	5.55	
Auxiliary	0.24	
Lighting	2.08	
Cooling	0.10	

The sample Output Documents and Energy Reports can be found in Appendix B.



6 'Be Clean' – Selection of Low Carbon Energy Supply Strategy

6.1 Connection to Existing Low Carbon Heating Infrastructure

The site is not located near an existing communal heating network.

6.2 Feasibility of CHP Scheme

It is not possible to incorporate a CHP (energy centre) into the scheme to meet the London Plan Hierarchy of providing 'clean' energy as the proposed development heat demand is not suitable for such technology.

Combined Heat and Power (CHP)

Combined heat and power generation (CHP) is an important technology for efficient fuel use and can use biomass or gas as the fuel source.

A gas-fired CHP is regarded as a low carbon technology, not a true renewable. Should the supply of fuel to the CHP be biomass then the system can be considered as a true renewable system.

CHP primarily offers carbon emission reductions by reducing the amount of electricity imported from the national grid – a 'carbon heavy' source of electricity.

The system produces electricity that can be used in the building or exported to the grid, and heat for space, water and even process heating. Systems must be heat led for high efficiency, which best suits applications to situations where there is a significant demand for heat for long periods of time (particularly through the summer period). This will also apply to residential developments, hospitals, hotels and leisure centres (swimming pools being ideal).

The split of heat to power and losses in both types of CHP systems are slightly different, but in principal each unit of gas supplied would generate approx 35% electricity, 50% heat and 15% in losses.

CHP units operate most efficiently when supplying the base load of the building. Given the nature of the building (predominantly domestic) the base load will be on the lower side and with peaks and troughs throughout the occupied period therefore the use of this technology has been deemed unsuitable for the site.

7 'Be Green' – Renewable Technologies

7.1 Green Technologies

Due to the site constraint it has been identified that none of the available renewable technology are deemed feasible for the site.

The energy strategy for the site instead focuses on maximising the efficiency of energy use.

Renewable technology options were investigated and discounted.

These alternative technologies included:

- Solar Thermal;
- Photovoltaic;
- Air Source Heat Pump;
- Wind Turbines;
- Biomass Boiler;
- Ground Source Heat Pump.

The justification for discounting these technologies can be found in Appendix C.

8 Conclusion

This report has followed the London Plan 2011 Strategy and Philosophy and in doing so has identified measures to improve energy efficiency and mitigate CO_2 emissions of the proposed development.

The following table provides a summary of the improvements recognised by each step of the energy hierarchy approach:

	Carbon Dioxide Emissions (Tonnes/ Annum)	CO_2 Emissions Reduction (%)
Baseline	64.77	-
Savings from energy demand reduction	29.60	45.71%
Savings from CHP	-	-
Savings from renewable energy	-	-
Total Target Savings	29.60	35%

This report has concluded that the proposed Heath House development incorporating the proposed enhanced building envelope and efficient building services systems is predicted to achieve a 45.71% improvement over the baseline via 'Be Lean' measures. Additionally the proposed scheme will comply with Building Regulations Part L1B 2013 and comply with the Greater London Authority and the London Borough of Camden's Planning requirements.

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Appendix A - Step One - Baseline Output Document and Energy Report Figures

SAP Input

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Property Details: Flat 6

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2015

Floor Location:	Floor area:	Storey height:
Basement floor	103.39 m²	3.1 m
Floor 1	110.92 m²	2.6 m

Living area:	50.2 m² (fraction 0.234)
Front of dwelling faces:	Unspecified

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
W1	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
W2	SAP 2012	Windows	Single-glazed	No	
W3	SAP 2012	Windows	Single-glazed	No	
W4	SAP 2012	Windows	Single-glazed	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
W1	16mm or more	0.7	0.65	1.5	1.43	2
W2		0.7	0.65	4.5	3.13	2
W3		0.7	0.85	4.5	2.5	1
W4		0.7	0.65	4.5	3.13	2
RF1	16mm or more	0.7	0.65	1.5	3.6	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
W1		Basement wall	North	0.95	1.5
W2		External wall	North	1.25	2.5
W3		External wall	West	1	2.5
W4		External wall	North	1.25	2.5
RF1		flat roof	Horizontal	4.5	0.8

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Basement wall	64.17	2.86	61.31	0.25	0	False	N/A
External wall	62.4	15.02	47.38	0.45	0	False	N/A
corridor	33.67	2.1	31.57	0.25	0.9	False	N/A

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flat roof	7.68	3.6	4.08	0.25	0	N/A
Basement floor	103.39			0.25		N/A

<u>Internal Elements</u>

<u>Party Elements</u>

party wall Basement	53.32	N/A
party ff	39.78	N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	No (Assumed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	4
Pressure test:	15

Main heating system:

Main heating system:

Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: SAP Tables
SAP Table: 115
Wall mounted
Systems with radiators
Design flow temperature: Unknown
Open
Boiler interlock: Yes

Main heating Control:

Main heating Control:

No time or thermostatic control of room temperature
Control code: 2101

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:

From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 250 litres
Cylinder insulation: Factory 15 mm
Primary pipework insulation: False
Cylinderstat: False
Cylinder in heated space: False
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	0%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None

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SAP Input

Assess Zero Carbon Home: No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 6

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	103.39	(1a)	x	3.1	(2a)	=	320.51	(3a)
Ground floor	110.92	(1b)	x	2.6	(2b)	=	288.39	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	214.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	608.9	(5)

2. Ventilation rate:

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

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				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.05	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.8	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.56	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	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

0.71	0.7	0.69	0.62	0.6	0.53	0.53	0.52	0.56	0.6	0.63	0.66

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=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(24d)

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

(25)m=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(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	2	=	4.2			(26)
Windows Type 1			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Windows Type 2			3.13	x1/[1/(4.5)+ 0.04]		=	11.94			(27)
Windows Type 3			2.5	x1/[1/(4.5)+ 0.04]		=	9.53			(27)
Windows Type 4			3.13	x1/[1/(4.5)+ 0.04]		=	11.94			(27)
Rooflights			3.6	x1/[1/(1.5) + 0.04]		=	5.4			(27b)
Floor			103.39	x	0.25	=	25.8475			(28)
Walls Type1	64.17	2.86	61.31	x	0.25	=	15.33			(29)
Walls Type2	62.4	15.02	47.38	x	0.45	=	21.32			(29)
Walls Type3	33.67	2.1	31.57	x	0.2	=	6.44			(29)
Roof	7.68	3.6	4.08	x	0.25	=	1.02			(30)
Total area of elements, m²			271.31							(31)
Party wall			53.32	x	0	=	0			(32)
Party wall			39.78	x	0	=	0			(32)

** 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) = 140.58 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 40.7 (36)

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

Total fabric heat loss — (33) + (36) = 181.28 (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=	151.59	149.61	147.66	138.52	136.81	128.85	128.85	127.38	131.92	136.81	140.27	143.89	(38)

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

(39)m=	332.87	330.88	328.94	319.8	318.09	310.13	310.13	308.65	313.19	318.09	321.55	325.17	

Average = $Sum(39)_{1...12}$ /12= 319.79 (39)

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

(40)m=	1.55	1.54	1.53	1.49	1.48	1.45	1.45	1.44	1.46	1.48	1.5	1.52	

Average = $Sum(40)_{1...12}$ /12= 1.49 (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:

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Assumed occupancy, N — 3.02 (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 — 105.94 (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=	116.53	112.29	108.06	103.82	99.58	95.34	95.34	99.58	103.82	108.06	112.29	116.53

Total = $Sum(44)_{1...12}$ = 1271.25 (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=	172.81	151.14	155.97	135.98	130.47	112.59	104.33	119.72	121.15	141.19	154.12	167.36

Total = $Sum(45)_{1...12}$ = 1666.81 (45)

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

(46)m=	25.92	22.67	23.39	20.4	19.57	16.89	15.65	17.96	18.17	21.18	23.12	25.1	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 250 (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) = 250 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.03 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0.78 (52)

Temperature factor from Table 2b — 0.78 (53)

SAP WorkSheet: New dwelling design stage

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Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 5.18 (54)

Enter (50) or (54) in (55) 5.18 (55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	461.87	412.22	445.02	415.7	419.52	310	308.32	323.71	318.56	430.24	433.84	456.41	(62)

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

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

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

Output from water heater

(64)m=	461.87	412.22	445.02	415.7	419.52	310	308.32	323.71	318.56	430.24	433.84	456.41

Output from water heater (annual)$_{1…12}$ 4735.41 (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=	160.16	143.02	154.56	144.6	146.08	70.97	69.34	74.46	73.81	149.65	150.63	158.35	(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=	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	(66)

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

(67)m=	190.9	169.56	137.89	104.39	78.04	65.88	71.19	92.53	124.2	157.7	184.05	196.21	(67)

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

(68)m=	573.81	579.76	564.76	532.81	492.49	454.59	429.27	423.32	438.33	470.27	510.59	548.49	(68)

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

(69)m=	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	(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=	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	(71)

Water heating gains (Table 5)

(72)m=	215.27	212.82	207.74	200.83	196.35	98.57	93.2	100.08	102.52	201.14	209.21	212.83	(72)

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

(73)m=	1096.54	1078.7	1026.95	954.6	883.43	735.6	710.22	732.48	781.6	945.66	1020.41	1074.09	(73)

6. Solar gains:

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

SAP WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.3	x	1.43	x	10.63	x	0.65	x	0.7	=	3.74	(74)
North	0.9x	1	x	3.13	x	10.63	x	0.65	x	0.7	=	27.26	(74)
North	0.9x	1	x	3.13	x	10.63	x	0.65	x	0.7	=	27.26	(74)
North	0.9x	0.3	x	1.43	x	20.32	x	0.65	x	0.7	=	7.14	(74)
North	0.9x	1	x	3.13	x	20.32	x	0.65	x	0.7	=	52.09	(74)
North	0.9x	1	x	3.13	x	20.32	x	0.65	x	0.7	=	52.09	(74)
North	0.9x	0.3	x	1.43	x	34.53	x	0.65	x	0.7	=	12.13	(74)
North	0.9x	1	x	3.13	x	34.53	x	0.65	x	0.7	=	88.52	(74)
North	0.9x	1	x	3.13	x	34.53	x	0.65	x	0.7	=	88.52	(74)
North	0.9x	0.3	x	1.43	x	55.46	x	0.65	x	0.7	=	19.49	(74)
North	0.9x	1	x	3.13	x	55.46	x	0.65	x	0.7	=	142.18	(74)
North	0.9x	1	x	3.13	x	55.46	x	0.65	x	0.7	=	142.18	(74)
North	0.9x	0.3	x	1.43	x	74.72	x	0.65	x	0.7	=	26.25	(74)
North	0.9x	1	x	3.13	x	74.72	x	0.65	x	0.7	=	191.53	(74)
North	0.9x	1	x	3.13	x	74.72	x	0.65	x	0.7	=	191.53	(74)
North	0.9x	0.3	x	1.43	x	79.99	x	0.65	x	0.7	=	28.1	(74)
North	0.9x	1	x	3.13	x	79.99	x	0.65	x	0.7	=	205.04	(74)
North	0.9x	1	x	3.13	x	79.99	x	0.65	x	0.7	=	205.04	(74)
North	0.9x	0.3	x	1.43	x	74.68	x	0.65	x	0.7	=	26.24	(74)
North	0.9x	1	x	3.13	x	74.68	x	0.65	x	0.7	=	191.43	(74)
North	0.9x	1	x	3.13	x	74.68	x	0.65	x	0.7	=	191.43	(74)
North	0.9x	0.3	x	1.43	x	59.25	x	0.65	x	0.7	=	20.82	(74)
North	0.9x	1	x	3.13	x	59.25	x	0.65	x	0.7	=	151.88	(74)
North	0.9x	1	x	3.13	x	59.25	x	0.65	x	0.7	=	151.88	(74)
North	0.9x	0.3	x	1.43	x	41.52	x	0.65	x	0.7	=	14.59	(74)
North	0.9x	1	x	3.13	x	41.52	x	0.65	x	0.7	=	106.43	(74)
North	0.9x	1	x	3.13	x	41.52	x	0.65	x	0.7	=	106.43	(74)
North	0.9x	0.3	x	1.43	x	24.19	x	0.65	x	0.7	=	8.5	(74)
North	0.9x	1	x	3.13	x	24.19	x	0.65	x	0.7	=	62.01	(74)
North	0.9x	1	x	3.13	x	24.19	x	0.65	x	0.7	=	62.01	(74)
North	0.9x	0.3	x	1.43	x	13.12	x	0.65	x	0.7	=	4.61	(74)
North	0.9x	1	x	3.13	x	13.12	x	0.65	x	0.7	=	33.63	(74)
North	0.9x	1	x	3.13	x	13.12	x	0.65	x	0.7	=	33.63	(74)
North	0.9x	0.3	x	1.43	x	8.86	x	0.65	x	0.7	=	3.11	(74)
North	0.9x	1	x	3.13	x	8.86	x	0.65	x	0.7	=	22.72	(74)
North	0.9x	1	x	3.13	x	8.86	x	0.65	x	0.7	=	22.72	(74)
West	0.9x	0.54	x	2.5	x	19.64	x	0.85	x	0.7	=	14.2	(80)
West	0.9x	0.54	x	2.5	x	38.42	x	0.85	x	0.7	=	27.78	(80)
West	0.9x	0.54	x	2.5	x	63.27	x	0.85	x	0.7	=	45.74	(80)

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SAP WorkSheet: New dwelling design stage

West	0.9x	0.54	x	2.5	x	92.28	x	0.85	x	0.7	=	66.71	(80)
West	0.9x	0.54	x	2.5	x	113.09	x	0.85	x	0.7	=	81.76	(80)
West	0.9x	0.54	x	2.5	x	115.77	x	0.85	x	0.7	=	83.69	(80)
West	0.9x	0.54	x	2.5	x	110.22	x	0.85	x	0.7	=	79.68	(80)
West	0.9x	0.54	x	2.5	x	94.68	x	0.85	x	0.7	=	68.44	(80)
West	0.9x	0.54	x	2.5	x	73.59	x	0.85	x	0.7	=	53.2	(80)
West	0.9x	0.54	x	2.5	x	45.59	x	0.85	x	0.7	=	32.96	(80)
West	0.9x	0.54	x	2.5	x	24.49	x	0.85	x	0.7	=	17.7	(80)
West	0.9x	0.54	x	2.5	x	16.15	x	0.85	x	0.7	=	11.68	(80)
Rooflights	0.9x	1	x	3.6	x	26	x	0.65	x	0.7	=	38.33	(82)
Rooflights	0.9x	1	x	3.6	x	54	x	0.65	x	0.7	=	79.61	(82)
Rooflights	0.9x	1	x	3.6	x	96	x	0.65	x	0.7	=	141.52	(82)
Rooflights	0.9x	1	x	3.6	x	150	x	0.65	x	0.7	=	221.13	(82)
Rooflights	0.9x	1	x	3.6	x	192	x	0.65	x	0.7	=	283.05	(82)
Rooflights	0.9x	1	x	3.6	x	200	x	0.65	x	0.7	=	294.84	(82)
Rooflights	0.9x	1	x	3.6	x	189	x	0.65	x	0.7	=	278.62	(82)
Rooflights	0.9x	1	x	3.6	x	157	x	0.65	x	0.7	=	231.45	(82)
Rooflights	0.9x	1	x	3.6	x	115	x	0.65	x	0.7	=	169.53	(82)
Rooflights	0.9x	1	x	3.6	x	66	x	0.65	x	0.7	=	97.3	(82)
Rooflights	0.9x	1	x	3.6	x	33	x	0.65	x	0.7	=	48.65	(82)
Rooflights	0.9x	1	x	3.6	x	21	x	0.65	x	0.7	=	30.96	(82)

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

(83)m=	110.78	218.71	376.43	591.69	774.12	816.72	767.4	624.46	450.17	262.77	138.21	91.2	(83)

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

(84)m=	1207.32	1297.4	1403.38	1546.29	1657.55	1552.31	1477.62	1356.94	1231.77	1208.43	1158.63	1165.28	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.99	0.96	0.89	0.77	0.83	0.96	0.99	1	1	(86)

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

(87)m=	19.22	19.35	19.62	20.03	20.43	20.75	20.91	20.88	20.59	20.13	19.63	19.23	(87)

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

(88)m=	20.22	20.23	20.23	20.25	20.26	20.28	20.28	20.28	20.27	20.26	20.25	20.24	(88)

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

(89)m=	1	1	0.99	0.98	0.94	0.85	0.69	0.75	0.94	0.99	1	1	(89)

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

(90)m=	18.55	18.68	18.95	19.38	19.78	20.1	20.23	20.21	19.95	19.48	18.98	18.58	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

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

SAP WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(92)m=	18.71	18.84	19.11	19.53	19.93	20.25	20.39	20.36	20.1	19.63	19.14	18.73		(92)

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

(93)m=	19.31	19.44	19.71	20.13	20.53	20.85	20.99	20.96	20.7	20.23	19.74	19.33		(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	1	1	0.99	0.98	0.95	0.89	0.77	0.82	0.95	0.99	1	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	1204.1	1292.38	1393.19	1518.19	1574.69	1374.62	1142.08	1116.84	1169.93	1192.44	1153.7	1162.68		(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=	4995.91	4810.89	4345.11	3592.94	2809.81	1938.16	1360.46	1408.74	2066.6	3064.11	4063.11	4919.96		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	2821.1	2364.44	2196.23	1493.82	918.93	0	0	0	0	1392.52	2094.78	2795.41		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													16077.22	(98)
Space heating requirement in kWh/m²/year													75.02	(99)

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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		61	(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)														
	2821.1	2364.44	2196.23	1493.82	918.93	0	0	0	0	1392.52	2094.78	2795.41		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	4624.76	3876.13	3600.37	2448.88	1506.44	0	0	0	0	2282.81	3434.06	4582.64		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													26356.1	(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)														
	461.87	412.22	445.02	415.7	419.52	310	308.32	323.71	318.56	430.24	433.84	456.41		
Efficiency of water heater													51	(216)
(217)m=	59.36	59.27	59.05	58.5	57.47	51	51	51	51	58.3	59.01	59.37		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	778.04	695.45	753.64	710.57	730.01	607.83	604.54	634.72	624.62	737.95	735.15	768.81		
Total = Sum(219a)$_{1...12}$ =													8381.34	(219)

SAP WorkSheet: New dwelling design stage

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			26356.1	
Water heating fuel used			8381.34	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)
Electricity for lighting			1348.56	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	917.19	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	291.67	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	26.51	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	177.88	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			1533.25	(255)

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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.48	(257)
SAP rating (Section 12)		65.36	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	5692.92	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	1810.37	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7503.29	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	104.32	(267)
Electricity for lighting	(232) x	0.519	=	699.9	(268)
Total CO2, kg/year		sum of (265)…(271) =		8307.51	(272)
CO2 emissions per m²		(272) ÷ (4) =		38.76	(273)

EI rating (section 14)				57	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	32154.44	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	10225.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			42379.67	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	617.07	(267)
Electricity for lighting	(232) x	0	=	4140.09	(268)
'Total Primary Energy		sum of (265)…(271) =		47136.84	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		219.95	(273)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 6

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	103.39	(1a)	x	3.1	(2a)	=	320.51	(3a)
Ground floor	110.92	(1b)	x	2.6	(2b)	=	288.39	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	214.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	608.9	(5)

2. Ventilation rate:

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.05	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.8	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.56	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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DER WorkSheet: New dwelling design stage

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

0.71	0.7	0.69	0.62	0.6	0.53	0.53	0.52	0.56	0.6	0.63	0.66

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=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(24d)

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

(25)m=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(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	2	=	4.2			(26)
Windows Type 1			1.43		x1/[1/(1.5)+ 0.04]	=	2.02			(27)
Windows Type 2			3.13		x1/[1/(4.5)+ 0.04]	=	11.94			(27)
Windows Type 3			2.5		x1/[1/(4.5)+ 0.04]	=	9.53			(27)
Windows Type 4			3.13		x1/[1/(4.5)+ 0.04]	=	11.94			(27)
Rooflights			3.6		x1/[1/(1.5) + 0.04]	=	5.4			(27b)
Floor			103.39	x	0.25	=	25.8475			(28)
Walls Type1	64.17	2.86	61.31	x	0.25	=	15.33			(29)
Walls Type2	62.4	15.02	47.38	x	0.45	=	21.32			(29)
Walls Type3	33.67	2.1	31.57	x	0.2	=	6.44			(29)
Roof	7.68	3.6	4.08	x	0.25	=	1.02			(30)
Total area of elements, m²			271.31							(31)
Party wall			53.32	x	0	=	0			(32)
Party wall			39.78	x	0	=	0			(32)

** 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) =	140.58	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 40.7 | (36)

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

Total fabric heat loss (33) + (36) = | 181.28 | (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=	151.59	149.61	147.66	138.52	136.81	128.85	128.85	127.38	131.92	136.81	140.27	143.89	(38)

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

(39)m=	332.87	330.88	328.94	319.8	318.09	310.13	310.13	308.65	313.19	318.09	321.55	325.17	

Average = $Sum(39)_{1...12}$ /12= | 319.79 | (39)

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

(40)m=	1.55	1.54	1.53	1.49	1.48	1.45	1.45	1.44	1.46	1.48	1.5	1.52	

Average = $Sum(40)_{1...12}$ /12= | 1.49 | (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 | 3.02 | (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 | 105.94 | (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=	116.53	112.29	108.06	103.82	99.58	95.34	95.34	99.58	103.82	108.06	112.29	116.53	

Total = $Sum(44)_{1...12}$ = | 1271.25 | (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=	172.81	151.14	155.97	135.98	130.47	112.59	104.33	119.72	121.15	141.19	154.12	167.36	

Total = $Sum(45)_{1...12}$ = | 1666.81 | (45)

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

(46)m=	25.92	22.67	23.39	20.4	19.57	16.89	15.65	17.96	18.17	21.18	23.12	25.1	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 250 | (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) = | 250 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.03 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0.78 | (52)

Temperature factor from Table 2b | 0.78 | (53)

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DER WorkSheet: New dwelling design stage

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Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 5.18 (54)

Enter (50) or (54) in (55) 5.18 (55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	461.87	412.22	445.02	415.7	419.52	310	308.32	323.71	318.56	430.24	433.84	456.41	(62)

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

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

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

Output from water heater

(64)m=	461.87	412.22	445.02	415.7	419.52	310	308.32	323.71	318.56	430.24	433.84	456.41

Output from water heater (annual)$_{1...12}$ 4735.41 (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=	160.16	143.02	154.56	144.6	146.08	70.97	69.34	74.46	73.81	149.65	150.63	158.35	(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=	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	(66)

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

(67)m=	66.64	59.19	48.14	36.44	27.24	23	24.85	32.3	43.36	55.05	64.25	68.49	(67)

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

(68)m=	384.45	388.44	378.39	356.98	329.97	304.58	287.61	283.62	293.68	315.08	342.1	367.49	(68)

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

(69)m=	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	(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=	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	(71)

Water heating gains (Table 5)

(72)m=	215.27	212.82	207.74	200.83	196.35	98.57	93.2	100.08	102.52	201.14	209.21	212.83	(72)

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

(73)m=	734.67	728.76	702.57	662.57	621.87	494.45	473.97	484.31	507.86	639.58	683.87	717.12	(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)	
North	0.9x	0.3	x	1.43	x	10.63	x	0.65	x	0.7	=	3.74	(74)
North	0.9x	0.77	x	3.13	x	10.63	x	0.65	x	0.7	=	20.99	(74)
North	0.9x	0.77	x	3.13	x	10.63	x	0.65	x	0.7	=	20.99	(74)
North	0.9x	0.3	x	1.43	x	20.32	x	0.65	x	0.7	=	7.14	(74)
North	0.9x	0.77	x	3.13	x	20.32	x	0.65	x	0.7	=	40.11	(74)
North	0.9x	0.77	x	3.13	x	20.32	x	0.65	x	0.7	=	40.11	(74)
North	0.9x	0.3	x	1.43	x	34.53	x	0.65	x	0.7	=	12.13	(74)
North	0.9x	0.77	x	3.13	x	34.53	x	0.65	x	0.7	=	68.16	(74)
North	0.9x	0.77	x	3.13	x	34.53	x	0.65	x	0.7	=	68.16	(74)
North	0.9x	0.3	x	1.43	x	55.46	x	0.65	x	0.7	=	19.49	(74)
North	0.9x	0.77	x	3.13	x	55.46	x	0.65	x	0.7	=	109.48	(74)
North	0.9x	0.77	x	3.13	x	55.46	x	0.65	x	0.7	=	109.48	(74)
North	0.9x	0.3	x	1.43	x	74.72	x	0.65	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	3.13	x	74.72	x	0.65	x	0.7	=	147.48	(74)
North	0.9x	0.77	x	3.13	x	74.72	x	0.65	x	0.7	=	147.48	(74)
North	0.9x	0.3	x	1.43	x	79.99	x	0.65	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	3.13	x	79.99	x	0.65	x	0.7	=	157.88	(74)
North	0.9x	0.77	x	3.13	x	79.99	x	0.65	x	0.7	=	157.88	(74)
North	0.9x	0.3	x	1.43	x	74.68	x	0.65	x	0.7	=	26.24	(74)
North	0.9x	0.77	x	3.13	x	74.68	x	0.65	x	0.7	=	147.4	(74)
North	0.9x	0.77	x	3.13	x	74.68	x	0.65	x	0.7	=	147.4	(74)
North	0.9x	0.3	x	1.43	x	59.25	x	0.65	x	0.7	=	20.82	(74)
North	0.9x	0.77	x	3.13	x	59.25	x	0.65	x	0.7	=	116.94	(74)
North	0.9x	0.77	x	3.13	x	59.25	x	0.65	x	0.7	=	116.94	(74)
North	0.9x	0.3	x	1.43	x	41.52	x	0.65	x	0.7	=	14.59	(74)
North	0.9x	0.77	x	3.13	x	41.52	x	0.65	x	0.7	=	81.95	(74)
North	0.9x	0.77	x	3.13	x	41.52	x	0.65	x	0.7	=	81.95	(74)
North	0.9x	0.3	x	1.43	x	24.19	x	0.65	x	0.7	=	8.5	(74)
North	0.9x	0.77	x	3.13	x	24.19	x	0.65	x	0.7	=	47.75	(74)
North	0.9x	0.77	x	3.13	x	24.19	x	0.65	x	0.7	=	47.75	(74)
North	0.9x	0.3	x	1.43	x	13.12	x	0.65	x	0.7	=	4.61	(74)
North	0.9x	0.77	x	3.13	x	13.12	x	0.65	x	0.7	=	25.89	(74)
North	0.9x	0.77	x	3.13	x	13.12	x	0.65	x	0.7	=	25.89	(74)
North	0.9x	0.3	x	1.43	x	8.86	x	0.65	x	0.7	=	3.11	(74)
North	0.9x	0.77	x	3.13	x	8.86	x	0.65	x	0.7	=	17.5	(74)
North	0.9x	0.77	x	3.13	x	8.86	x	0.65	x	0.7	=	17.5	(74)
West	0.9x	0.54	x	2.5	x	19.64	x	0.85	x	0.7	=	14.2	(80)
West	0.9x	0.54	x	2.5	x	38.42	x	0.85	x	0.7	=	27.78	(80)
West	0.9x	0.54	x	2.5	x	63.27	x	0.85	x	0.7	=	45.74	(80)

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West	0.9x	0.54	x	2.5	x	92.28	x	0.85	x	0.7	=	66.71	(80)
West	0.9x	0.54	x	2.5	x	113.09	x	0.85	x	0.7	=	81.76	(80)
West	0.9x	0.54	x	2.5	x	115.77	x	0.85	x	0.7	=	83.69	(80)
West	0.9x	0.54	x	2.5	x	110.22	x	0.85	x	0.7	=	79.68	(80)
West	0.9x	0.54	x	2.5	x	94.68	x	0.85	x	0.7	=	68.44	(80)
West	0.9x	0.54	x	2.5	x	73.59	x	0.85	x	0.7	=	53.2	(80)
West	0.9x	0.54	x	2.5	x	45.59	x	0.85	x	0.7	=	32.96	(80)
West	0.9x	0.54	x	2.5	x	24.49	x	0.85	x	0.7	=	17.7	(80)
West	0.9x	0.54	x	2.5	x	16.15	x	0.85	x	0.7	=	11.68	(80)
Rooflights	0.9x	1	x	3.6	x	26	x	0.65	x	0.7	=	38.33	(82)
Rooflights	0.9x	1	x	3.6	x	54	x	0.65	x	0.7	=	79.61	(82)
Rooflights	0.9x	1	x	3.6	x	96	x	0.65	x	0.7	=	141.52	(82)
Rooflights	0.9x	1	x	3.6	x	150	x	0.65	x	0.7	=	221.13	(82)
Rooflights	0.9x	1	x	3.6	x	192	x	0.65	x	0.7	=	283.05	(82)
Rooflights	0.9x	1	x	3.6	x	200	x	0.65	x	0.7	=	294.84	(82)
Rooflights	0.9x	1	x	3.6	x	189	x	0.65	x	0.7	=	278.62	(82)
Rooflights	0.9x	1	x	3.6	x	157	x	0.65	x	0.7	=	231.45	(82)
Rooflights	0.9x	1	x	3.6	x	115	x	0.65	x	0.7	=	169.53	(82)
Rooflights	0.9x	1	x	3.6	x	66	x	0.65	x	0.7	=	97.3	(82)
Rooflights	0.9x	1	x	3.6	x	33	x	0.65	x	0.7	=	48.65	(82)
Rooflights	0.9x	1	x	3.6	x	21	x	0.65	x	0.7	=	30.96	(82)

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

(83)m=	98.24	194.74	335.71	526.29	686.01	722.4	679.34	554.6	401.22	234.25	122.75	80.74	(83)

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

(84)m=	832.91	923.51	1038.29	1188.86	1307.88	1216.85	1153.32	1038.91	909.08	873.82	806.61	797.87	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.95	0.87	0.91	0.98	1	1	1	(86)

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

(87)m=	19.07	19.2	19.47	19.89	20.31	20.65	20.85	20.8	20.47	19.99	19.49	19.08	(87)

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

(88)m=	20.22	20.23	20.23	20.25	20.26	20.28	20.28	20.28	20.27	20.26	20.25	20.24	(88)

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

(89)m=	1	1	1	0.99	0.97	0.92	0.8	0.86	0.98	1	1	1	(89)

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

(90)m=	18.4	18.53	18.81	19.24	19.66	20.01	20.19	20.15	19.84	19.35	18.84	18.43	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

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

(92)m=	18.56	18.69	18.96	19.39	19.81	20.16	20.34	20.31	19.99	19.5	18.99	18.58	(92)

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

(93)m=	19.16	19.29	19.56	19.99	20.41	20.76	20.94	20.91	20.59	20.1	19.59	19.18	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.98	0.94	0.86	0.91	0.98	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	832.34	922.45	1035.66	1179.92	1275.86	1143.41	997.23	940.53	891.2	870.07	805.7	797.43	(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=	4945.31	4760.73	4296.8	3548.16	2771.01	1911.01	1346.73	1390.72	2031.32	3021.67	4016.93	4871.11	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3060.05	2579.33	2426.28	1705.14	1112.39	0	0	0	0	1600.79	2312.08	3030.82	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 17826.88 (98)

Space heating requirement in kWh/m²/year 83.18 (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		61	(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)													
	3060.05	2579.33	2426.28	1705.14	1112.39	0	0	0	0	1600.79	2312.08	3030.82	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	5016.48	4228.4	3977.51	2795.31	1823.6	0	0	0	0	2624.25	3790.3	4968.55	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 29224.4 (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)

	461.87	412.22	445.02	415.7	419.52	310	308.32	323.71	318.56	430.24	433.84	456.41

Efficiency of water heater 51 (216)

(217)m=	59.47	59.4	59.2	58.74	57.89	51	51	51	51	58.57	59.17	59.47	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	776.63	694.03	751.71	707.67	724.67	607.83	604.54	634.72	624.62	734.61	733.25	767.42

Total = Sum(219a)$_{1...12}$ = 8361.71 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			29224.4	
Water heating fuel used			8361.71	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)
Electricity for lighting			1176.93	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	6312.47	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1806.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =				8118.6	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	104.32	(267)
Electricity for lighting	(232)	x	0.519	=	610.83	(268)
Total CO2, kg/year			sum of (265)…(271) =		8833.75	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		41.22	(273)
EI rating (section 14)					54	(274)

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SAP Input

Property Details: Flat 4

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2015

Floor Location:	Floor area:	Storey height:
Basement floor	55.52 m²	3.1 m
Floor 1	83.55 m²	2.6 m
Floor 2	85.82 m²	3.28 m

Living area: 41.96 m² (fraction 0.187)

Front of dwelling faces: Unspecified

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
W1	SAP 2012	Windows	Single-glazed	No	
W2	Manufacturer	Windows	Single-glazed	No	
W3	SAP 2012	Windows	Single-glazed	No	
W3	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
W1		0.7	0.85	4.5	1.5	3
W2		0.7	0.85	1.5	5	2
W3		0.7	0.85	4.5	1.8	2
W3	16mm or more	0.7	0.85	1.5	6.25	1
RF1	16mm or more	0.7	0.65	1.5	3.45	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
W1		External wall GF	South	1	1.5
W2		External wall GF	North	2	2.5
W3		External wall	North	1	1.8
W3		External wall GF	West	2.5	2.5
RF1		flat roof	Horizontal	2.3	1.5

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:

SAP Input

<u>External Elements</u>							
Basement wall	76.26	0	76.26	0.25	0	False	N/A
External wall GF	80.4	20.75	59.65	0.45	0	False	N/A
corridor GF	13.266	0	13.27	0.25	0.9	False	N/A
Coprridor FF	9.84	0	9.84	0.25	0.9	False	N/A
External FF	69.864	0	69.86	0.45	0	False	N/A
flat roof 1	6	0	6	0.2	0		N/A
Flat roof 2	28.23	0	28.23	0.2	0		N/A
flat roof 3	12.9	0	12.9	0.2	0		N/A
Basement floor	55.52			0.25			N/A
ground floor	28.03			0.25			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
party wall Basement	24.18						N/A
party GF	43.684						N/A
Party wall FF	67.24						N/A

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	No (Assumed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	1 (main: 0, secondary: 0, other: 1)
Number of open flues:	0
Number of fans:	4
Number of passive stacks:	0
Number of sides sheltered:	4
Pressure test:	15

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Main heating system:

Main heating system:

Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: SAP Tables
SAP Table: 115
Wall mounted
Systems with radiators
Design flow temperature: Unknown
Open
Boiler interlock: Yes

Main heating Control:

Main heating Control:

No time or thermostatic control of room temperature
Control code: 2101

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:

From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 250 litres
Cylinder insulation: Factory 15 mm
Primary pipework insulation: False
Cylinderstat: False
Cylinder in heated space: False
Solar panel: False

SAP Input

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.52	(1a)	x	3.1	(2a)	=	172.11	(3a)
Ground floor	83.55	(1b)	x	2.6	(2b)	=	217.23	(3b)
First floor	85.82	(1c)	x	3.28	(2c)	=	281.49	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	224.89	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	670.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.12	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.87	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

SAP WorkSheet: New dwelling design stage

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

0.78	0.76	0.75	0.67	0.65	0.58	0.58	0.56	0.61	0.65	0.68	0.71

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=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(24d)

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

(25)m=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m^2)	Openings m^2	Net Area A ,m^2		U-value W/m2K		A X U (W/K)	k-value kJ/m^2·K	A X k kJ/K	
Doors			2.1	x	2	=	4.2			(26)
Windows Type 1			1.5	x1/[1/(4.5)+ 0.04]		=	5.72			(27)
Windows Type 2			5	x1/[1/(1.5)+ 0.04]		=	7.08			(27)
Windows Type 3			1.8	x1/[1/(4.5)+ 0.04]		=	6.86			(27)
Windows Type 4			6.25	x1/[1/(1.5)+ 0.04]		=	8.84			(27)
Rooflights			3.45	x1/[1/(1.5) + 0.04]		=	5.175			(27b)
Floor Type 1			55.52	x	0.25	=	13.88			(28)
Floor Type 2			28.03	x	0.25	=	7.0075			(28)
Walls Type1	76.26	0	76.26	x	0.25	=	19.07			(29)
Walls Type2	80.4	20.75	59.65	x	0.45	=	26.84			(29)
Walls Type3	13.27	0	13.27	x	0.2	=	2.71			(29)
Walls Type4	9.84	0	9.84	x	0.2	=	2.01			(29)
Walls Type5	69.86	0	69.86	x	0.45	=	31.44			(29)
Roof Type1	6	0	6	x	0.2	=	1.2			(30)
Roof Type2	28.23	0	28.23	x	0.2	=	5.65			(30)
Roof Type3	12.9	0	12.9	x	0.2	=	2.58			(30)
Total area of elements, m^2			389.46							(31)

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SAP WorkSheet: New dwelling design stage

Party wall	24.18	x	0	=	0			(32)
Party wall	43.68	x	0	=	0			(32)
Party wall	67.24	x	0	=	0			(32)

** 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) =	175.34	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		58.42	(36)

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

Total fabric heat loss	(33) + (36) =	233.76	(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=	177.31	174.72	172.19	160.27	158.05	147.67	147.67	145.75	151.67	158.05	162.55	167.27	(38)

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

(39)m=	411.07	408.48	405.95	394.04	391.81	381.43	381.43	379.51	385.43	391.81	396.32	401.03	

Average = $Sum(39)_{1…12}$ /12= 394.03 (39)

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

(40)m=	1.83	1.82	1.81	1.75	1.74	1.7	1.7	1.69	1.71	1.74	1.76	1.78	

Average = $Sum(40)_{1…12}$ /12= 1.75 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 3.03 (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 — 106.26 (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=	116.89	112.64	108.39	104.14	99.89	95.64	95.64	99.89	104.14	108.39	112.64	116.89	
											Total = $Sum(44)_{1…12}$ =	1275.17	(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=	173.35	151.61	156.45	136.39	130.87	112.93	104.65	120.09	121.52	141.62	154.59	167.88	
											Total = $Sum(45)_{1…12}$ =	1671.95	(45)
	If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)												
(46)m=	26	22.74	23.47	20.46	19.63	16.94	15.7	18.01	18.23	21.24	23.19	25.18	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 250 (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)

SAP WorkSheet: New dwelling design stage

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.03	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.78	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	5.18	(54)
Enter (50) or (54) in (55)		5.18	(55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	462.4	412.69	445.5	416.12	419.93	310.34	308.64	324.08	318.93	430.67	434.32	456.93	(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=	462.4	412.69	445.5	416.12	419.93	310.34	308.64	324.08	318.93	430.67	434.32	456.93

Output from water heater (annual)$_{1...12}$ | 4740.55 | (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=	160.34	143.17	154.72	144.74	146.22	71.08	69.45	74.58	73.94	149.79	150.79	158.52	(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=	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	(66)

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

(67)m=	94.19	83.66	68.04	51.51	38.5	32.51	35.12	45.65	61.28	77.8	90.81	96.81	(67)

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

(68)m=	588.25	594.35	578.97	546.22	504.89	466.03	440.08	433.98	449.36	482.1	523.44	562.29	(68)

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

(69)m=	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	(71)

Water heating gains (Table 5)

(72)m=	215.51	213.05	207.96	201.03	196.53	98.73	93.34	100.24	102.69	201.33	209.43	213.07	(72)

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

(73)m=	1014.87	1007.99	971.89	915.68	856.84	714.19	685.47	696.8	730.25	878.17	940.61	989.09	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	1	x	5	x	10.63	x	0.85	x	0.7	=	56.94	(74)
North	0.9x	0.54	x	1.8	x	10.63	x	0.85	x	0.7	=	11.07	(74)
North	0.9x	1	x	5	x	20.32	x	0.85	x	0.7	=	108.82	(74)
North	0.9x	0.54	x	1.8	x	20.32	x	0.85	x	0.7	=	21.15	(74)
North	0.9x	1	x	5	x	34.53	x	0.85	x	0.7	=	184.91	(74)
North	0.9x	0.54	x	1.8	x	34.53	x	0.85	x	0.7	=	35.95	(74)
North	0.9x	1	x	5	x	55.46	x	0.85	x	0.7	=	297.01	(74)
North	0.9x	0.54	x	1.8	x	55.46	x	0.85	x	0.7	=	57.74	(74)
North	0.9x	1	x	5	x	74.72	x	0.85	x	0.7	=	400.1	(74)
North	0.9x	0.54	x	1.8	x	74.72	x	0.85	x	0.7	=	77.78	(74)
North	0.9x	1	x	5	x	79.99	x	0.85	x	0.7	=	428.32	(74)
North	0.9x	0.54	x	1.8	x	79.99	x	0.85	x	0.7	=	83.27	(74)
North	0.9x	1	x	5	x	74.68	x	0.85	x	0.7	=	399.89	(74)
North	0.9x	0.54	x	1.8	x	74.68	x	0.85	x	0.7	=	77.74	(74)
North	0.9x	1	x	5	x	59.25	x	0.85	x	0.7	=	317.26	(74)
North	0.9x	0.54	x	1.8	x	59.25	x	0.85	x	0.7	=	61.68	(74)
North	0.9x	1	x	5	x	41.52	x	0.85	x	0.7	=	222.32	(74)
North	0.9x	0.54	x	1.8	x	41.52	x	0.85	x	0.7	=	43.22	(74)
North	0.9x	1	x	5	x	24.19	x	0.85	x	0.7	=	129.53	(74)
North	0.9x	0.54	x	1.8	x	24.19	x	0.85	x	0.7	=	25.18	(74)
North	0.9x	1	x	5	x	13.12	x	0.85	x	0.7	=	70.25	(74)
North	0.9x	0.54	x	1.8	x	13.12	x	0.85	x	0.7	=	13.66	(74)
North	0.9x	1	x	5	x	8.86	x	0.85	x	0.7	=	47.47	(74)
North	0.9x	0.54	x	1.8	x	8.86	x	0.85	x	0.7	=	9.23	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	33.8	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	55.35	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	70.51	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	79.69	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	83.04	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	79.92	(78)

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South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	78.08	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	75.83	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	73.66	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	59.7	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	40.06	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	29.2	(78)
West	0.9x	1	x	6.25	x	19.64	x	0.85	x	0.7	=	65.73	(80)
West	0.9x	1	x	6.25	x	38.42	x	0.85	x	0.7	=	128.59	(80)
West	0.9x	1	x	6.25	x	63.27	x	0.85	x	0.7	=	211.77	(80)
West	0.9x	1	x	6.25	x	92.28	x	0.85	x	0.7	=	308.85	(80)
West	0.9x	1	x	6.25	x	113.09	x	0.85	x	0.7	=	378.51	(80)
West	0.9x	1	x	6.25	x	115.77	x	0.85	x	0.7	=	387.47	(80)
West	0.9x	1	x	6.25	x	110.22	x	0.85	x	0.7	=	368.89	(80)
West	0.9x	1	x	6.25	x	94.68	x	0.85	x	0.7	=	316.87	(80)
West	0.9x	1	x	6.25	x	73.59	x	0.85	x	0.7	=	246.29	(80)
West	0.9x	1	x	6.25	x	45.59	x	0.85	x	0.7	=	152.58	(80)
West	0.9x	1	x	6.25	x	24.49	x	0.85	x	0.7	=	81.96	(80)
West	0.9x	1	x	6.25	x	16.15	x	0.85	x	0.7	=	54.06	(80)
Rooflights	0.9x	1	x	3.45	x	26	x	0.65	x	0.7	=	36.73	(82)
Rooflights	0.9x	1	x	3.45	x	54	x	0.65	x	0.7	=	76.29	(82)
Rooflights	0.9x	1	x	3.45	x	96	x	0.65	x	0.7	=	135.63	(82)
Rooflights	0.9x	1	x	3.45	x	150	x	0.65	x	0.7	=	211.92	(82)
Rooflights	0.9x	1	x	3.45	x	192	x	0.65	x	0.7	=	271.25	(82)
Rooflights	0.9x	1	x	3.45	x	200	x	0.65	x	0.7	=	282.55	(82)
Rooflights	0.9x	1	x	3.45	x	189	x	0.65	x	0.7	=	267.01	(82)
Rooflights	0.9x	1	x	3.45	x	157	x	0.65	x	0.7	=	221.81	(82)
Rooflights	0.9x	1	x	3.45	x	115	x	0.65	x	0.7	=	162.47	(82)
Rooflights	0.9x	1	x	3.45	x	66	x	0.65	x	0.7	=	93.24	(82)
Rooflights	0.9x	1	x	3.45	x	33	x	0.65	x	0.7	=	46.62	(82)
Rooflights	0.9x	1	x	3.45	x	21	x	0.65	x	0.7	=	29.67	(82)

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

(83)m=	204.28	390.2	638.76	955.21	1210.69	1261.53	1191.62	993.44	747.96	460.24	252.55	169.63	(83)

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

(84)m=	1219.15	1398.2	1610.65	1870.89	2067.53	1975.72	1877.09	1690.24	1478.21	1338.41	1193.16	1158.72	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.86	0.74	0.8	0.95	0.99	1	1	(86)

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

(87)m=	18.9	19.07	19.4	19.9	20.36	20.72	20.89	20.85	20.52	19.96	19.38	18.91	(87)

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

(88)m=	20.09	20.09	20.1	20.12	20.13	20.15	20.15	20.16	20.14	20.13	20.12	20.11	(88)

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

(89)m=	1	1	0.99	0.97	0.92	0.82	0.65	0.72	0.92	0.98	1	1	(89)

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

(90)m=	18.13	18.3	18.63	19.15	19.6	19.96	20.1	20.08	19.78	19.22	18.63	18.15	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	18.27	18.44	18.78	19.29	19.75	20.1	20.25	20.22	19.92	19.36	18.77	18.29	(92)

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

(93)m=	18.87	19.04	19.38	19.89	20.35	20.7	20.85	20.82	20.52	19.96	19.37	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=	1	1	0.99	0.97	0.93	0.85	0.73	0.79	0.93	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1215.64	1391.29	1593.8	1819.81	1920.33	1675.13	1364.5	1328.83	1381.06	1316.9	1187.63	1156.03	(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=	5989.53	5777.25	5227.27	4328.68	3387.25	2327.22	1619.6	1677.47	2473.17	3666.26	4861.58	5892.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3551.78	2947.36	2703.3	1806.39	1091.38	0	0	0	0	1747.92	2645.24	3524.14	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 20017.52 (98)

Space heating requirement in kWh/m²/year 89.01 (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		61	(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)													
	3551.78	2947.36	2703.3	1806.39	1091.38	0	0	0	0	1747.92	2645.24	3524.14	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	5822.59	4831.74	4431.64	2961.29	1789.16	0	0	0	0	2865.45	4336.46	5777.28	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 32815.61 (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)

SAP WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	462.4	412.69	445.5	416.12	419.93	310.34	308.64	324.08	318.93	430.67	434.32	456.93	
Efficiency of water heater													51 (216)
(217)m=	59.65	59.57	59.35	58.84	57.85	51	51	51	51	58.72	59.36	59.66	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	775.15	692.83	750.59	707.21	725.91	608.51	605.17	635.44	625.35	733.39	731.69	765.92

Total = Sum(219a)$_{1...12}$ = 8357.18 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		32815.61	
Water heating fuel used		8357.18	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	156		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		201	(231)
Electricity for lighting		665.36	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	1141.98	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	290.83	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	26.51	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	87.76	(250)
Additional standing charges (Table 12)				120	(251)

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

Total energy cost (245)...(247) + (250)…(254) = 1667.09 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.59	(257)
SAP rating (Section 12)		63.81	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	7088.17	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	1805.15	(264)
Space and water heating	(261) + (262) + (263) + (264) =			8893.32	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	104.32	(267)
Electricity for lighting	(232) x	0.519	=	345.32	(268)
Total CO2, kg/year		sum of (265)…(271) =		9342.96	(272)
CO2 emissions per m²		(272) ÷ (4) =		41.54	(273)
EI rating (section 14)				54	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	40035.04	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	10195.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			50230.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	617.07	(267)
Electricity for lighting	(232) x	0	=	2042.66	(268)
'Total Primary Energy		sum of (265)…(271) =		52890.53	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		235.18	(273)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.52	(1a)	x	3.1	(2a)	=	172.11	(3a)
Ground floor	83.55	(1b)	x	2.6	(2b)	=	217.23	(3b)
First floor	85.82	(1c)	x	3.28	(2c)	=	281.49	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	224.89	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	670.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.12	(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		15	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.87	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

DER WorkSheet: New dwelling design stage

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

0.78	0.76	0.75	0.67	0.65	0.58	0.58	0.56	0.61	0.65	0.68	0.71

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=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(24d)

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

(25)m=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	2	=	4.2			(26)
Windows Type 1			1.5	x1/[1/(4.5)+ 0.04]		=	5.72			(27)
Windows Type 2			5	x1/[1/(1.5)+ 0.04]		=	7.08			(27)
Windows Type 3			1.8	x1/[1/(4.5)+ 0.04]		=	6.86			(27)
Windows Type 4			6.25	x1/[1/(1.5)+ 0.04]		=	8.84			(27)
Rooflights			3.45	x1/[1/(1.5) + 0.04]		=	5.175			(27b)
Floor Type 1			55.52	x	0.25	=	13.88			(28)
Floor Type 2			28.03	x	0.25	=	7.0075			(28)
Walls Type1	76.26	0	76.26	x	0.25	=	19.07			(29)
Walls Type2	80.4	20.75	59.65	x	0.45	=	26.84			(29)
Walls Type3	13.27	0	13.27	x	0.2	=	2.71			(29)
Walls Type4	9.84	0	9.84	x	0.2	=	2.01			(29)
Walls Type5	69.86	0	69.86	x	0.45	=	31.44			(29)
Roof Type1	6	0	6	x	0.2	=	1.2			(30)
Roof Type2	28.23	0	28.23	x	0.2	=	5.65			(30)
Roof Type3	12.9	0	12.9	x	0.2	=	2.58			(30)
Total area of elements, m²			389.46							(31)

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DER WorkSheet: New dwelling design stage

Party wall	24.18	x	0	=	0				(32)
Party wall	43.68	x	0	=	0				(32)
Party wall	67.24	x	0	=	0				(32)

** 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) = 175.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 58.42 (36)

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

Total fabric heat loss (33) + (36) = 233.76 (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=	177.31	174.72	172.19	160.27	158.05	147.67	147.67	145.75	151.67	158.05	162.55	167.27	(38)

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

(39)m=	411.07	408.48	405.95	394.04	391.81	381.43	381.43	379.51	385.43	391.81	396.32	401.03	

Average = $Sum(39)_{1…12}$ /12= 394.03 (39)

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

(40)m=	1.83	1.82	1.81	1.75	1.74	1.7	1.7	1.69	1.71	1.74	1.76	1.78	

Average = $Sum(40)_{1…12}$ /12= 1.75 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.03 (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) + 36 106.26 (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=	116.89	112.64	108.39	104.14	99.89	95.64	95.64	99.89	104.14	108.39	112.64	116.89	

Total = $Sum(44)_{1…12}$ = 1275.17 (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=	173.35	151.61	156.45	136.39	130.87	112.93	104.65	120.09	121.52	141.62	154.59	167.88	

Total = $Sum(45)_{1…12}$ = 1671.95 (45)

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

(46)m=	26	22.74	23.47	20.46	19.63	16.94	15.7	18.01	18.23	21.24	23.19	25.18	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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)

DER WorkSheet: New dwelling design stage

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.03	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.78	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	5.18	(54)
Enter (50) or (54) in (55)		5.18	(55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	462.4	412.69	445.5	416.12	419.93	310.34	308.64	324.08	318.93	430.67	434.32	456.93	(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=	462.4	412.69	445.5	416.12	419.93	310.34	308.64	324.08	318.93	430.67	434.32	456.93

Output from water heater (annual)$_{1...12}$ | 4740.55 | (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=	160.34	143.17	154.72	144.74	146.22	71.08	69.45	74.58	73.94	149.79	150.79	158.52	(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=	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	(66)

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

(67)m=	38.69	34.36	27.95	21.16	15.82	13.35	14.43	18.75	25.17	31.96	37.3	39.77	(67)

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

(68)m=	394.13	398.22	387.91	365.97	338.27	312.24	294.85	290.76	301.07	323.01	350.71	376.74	(68)

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

(69)m=	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	(71)

Water heating gains (Table 5)

(72)m=	215.51	213.05	207.96	201.03	196.53	98.73	93.34	100.24	102.69	201.33	209.43	213.07	(72)

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

(73)m=	716.84	714.15	692.33	656.67	619.13	492.84	471.14	478.27	497.45	624.82	665.95	698.08	(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	5	x	10.63	x	0.85	x	0.7	=	43.85	(74)
North	0.9x	0.54	x	1.8	x	10.63	x	0.85	x	0.7	=	11.07	(74)
North	0.9x	0.77	x	5	x	20.32	x	0.85	x	0.7	=	83.79	(74)
North	0.9x	0.54	x	1.8	x	20.32	x	0.85	x	0.7	=	21.15	(74)
North	0.9x	0.77	x	5	x	34.53	x	0.85	x	0.7	=	142.38	(74)
North	0.9x	0.54	x	1.8	x	34.53	x	0.85	x	0.7	=	35.95	(74)
North	0.9x	0.77	x	5	x	55.46	x	0.85	x	0.7	=	228.7	(74)
North	0.9x	0.54	x	1.8	x	55.46	x	0.85	x	0.7	=	57.74	(74)
North	0.9x	0.77	x	5	x	74.72	x	0.85	x	0.7	=	308.08	(74)
North	0.9x	0.54	x	1.8	x	74.72	x	0.85	x	0.7	=	77.78	(74)
North	0.9x	0.77	x	5	x	79.99	x	0.85	x	0.7	=	329.81	(74)
North	0.9x	0.54	x	1.8	x	79.99	x	0.85	x	0.7	=	83.27	(74)
North	0.9x	0.77	x	5	x	74.68	x	0.85	x	0.7	=	307.92	(74)
North	0.9x	0.54	x	1.8	x	74.68	x	0.85	x	0.7	=	77.74	(74)
North	0.9x	0.77	x	5	x	59.25	x	0.85	x	0.7	=	244.29	(74)
North	0.9x	0.54	x	1.8	x	59.25	x	0.85	x	0.7	=	61.68	(74)
North	0.9x	0.77	x	5	x	41.52	x	0.85	x	0.7	=	171.19	(74)
North	0.9x	0.54	x	1.8	x	41.52	x	0.85	x	0.7	=	43.22	(74)
North	0.9x	0.77	x	5	x	24.19	x	0.85	x	0.7	=	99.74	(74)
North	0.9x	0.54	x	1.8	x	24.19	x	0.85	x	0.7	=	25.18	(74)
North	0.9x	0.77	x	5	x	13.12	x	0.85	x	0.7	=	54.09	(74)
North	0.9x	0.54	x	1.8	x	13.12	x	0.85	x	0.7	=	13.66	(74)
North	0.9x	0.77	x	5	x	8.86	x	0.85	x	0.7	=	36.55	(74)
North	0.9x	0.54	x	1.8	x	8.86	x	0.85	x	0.7	=	9.23	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	33.8	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	55.35	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	70.51	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	79.69	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	83.04	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	79.92	(78)

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DER WorkSheet: New dwelling design stage

South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	78.08	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	75.83	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	73.66	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	59.7	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	40.06	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	29.2	(78)
West	0.9x	0.77	x	6.25	x	19.64	x	0.85	x	0.7	=	50.61	(80)
West	0.9x	0.77	x	6.25	x	38.42	x	0.85	x	0.7	=	99.01	(80)
West	0.9x	0.77	x	6.25	x	63.27	x	0.85	x	0.7	=	163.06	(80)
West	0.9x	0.77	x	6.25	x	92.28	x	0.85	x	0.7	=	237.81	(80)
West	0.9x	0.77	x	6.25	x	113.09	x	0.85	x	0.7	=	291.45	(80)
West	0.9x	0.77	x	6.25	x	115.77	x	0.85	x	0.7	=	298.35	(80)
West	0.9x	0.77	x	6.25	x	110.22	x	0.85	x	0.7	=	284.04	(80)
West	0.9x	0.77	x	6.25	x	94.68	x	0.85	x	0.7	=	243.99	(80)
West	0.9x	0.77	x	6.25	x	73.59	x	0.85	x	0.7	=	189.65	(80)
West	0.9x	0.77	x	6.25	x	45.59	x	0.85	x	0.7	=	117.49	(80)
West	0.9x	0.77	x	6.25	x	24.49	x	0.85	x	0.7	=	63.11	(80)
West	0.9x	0.77	x	6.25	x	16.15	x	0.85	x	0.7	=	41.62	(80)
Rooflights	0.9x	1	x	3.45	x	26	x	0.65	x	0.7	=	36.73	(82)
Rooflights	0.9x	1	x	3.45	x	54	x	0.65	x	0.7	=	76.29	(82)
Rooflights	0.9x	1	x	3.45	x	96	x	0.65	x	0.7	=	135.63	(82)
Rooflights	0.9x	1	x	3.45	x	150	x	0.65	x	0.7	=	211.92	(82)
Rooflights	0.9x	1	x	3.45	x	192	x	0.65	x	0.7	=	271.25	(82)
Rooflights	0.9x	1	x	3.45	x	200	x	0.65	x	0.7	=	282.55	(82)
Rooflights	0.9x	1	x	3.45	x	189	x	0.65	x	0.7	=	267.01	(82)
Rooflights	0.9x	1	x	3.45	x	157	x	0.65	x	0.7	=	221.81	(82)
Rooflights	0.9x	1	x	3.45	x	115	x	0.65	x	0.7	=	162.47	(82)
Rooflights	0.9x	1	x	3.45	x	66	x	0.65	x	0.7	=	93.24	(82)
Rooflights	0.9x	1	x	3.45	x	33	x	0.65	x	0.7	=	46.62	(82)
Rooflights	0.9x	1	x	3.45	x	21	x	0.65	x	0.7	=	29.67	(82)

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

(83)m=	176.06	335.6	547.52	815.86	1031.61	1073.9	1014.8	847.59	640.18	395.36	217.54	146.28	(83)

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

(84)m=	892.9	1049.75	1239.85	1472.53	1650.74	1566.73	1485.94	1325.87	1137.63	1020.17	883.49	844.36	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.92	0.83	0.88	0.97	1	1	1	(86)

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

(87)m=	18.78	18.94	19.27	19.75	20.23	20.62	20.83	20.78	20.41	19.85	19.26	18.79	(87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.09	20.09	20.1	20.12	20.13	20.15	20.15	20.16	20.14	20.13	20.12	20.11	(88)

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

(89)m=	1	1	1	0.99	0.96	0.89	0.75	0.82	0.96	0.99	1	1	(89)

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

(90)m=	18.01	18.17	18.5	19.01	19.48	19.88	20.06	20.03	19.68	19.1	18.51	18.04	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	18.15	18.31	18.64	19.15	19.62	20.02	20.21	20.17	19.81	19.24	18.65	18.18	(92)

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

(93)m=	18.75	18.91	19.24	19.75	20.22	20.62	20.81	20.77	20.41	19.84	19.25	18.78	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.96	0.91	0.82	0.87	0.97	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	891.96	1047.67	1234.05	1452.48	1584.75	1423.37	1214.91	1149.72	1100.26	1013.03	881.95	843.67	(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=	5939.98	5724.81	5172.5	4273.88	3338.33	2294.49	1603.97	1657.25	2433.32	3621.21	4815.94	5845.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3755.73	3143.04	2930.21	2031.41	1304.67	0	0	0	0	1940.49	2832.47	3721.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 21659.6 (98)

Space heating requirement in kWh/m²/year 96.31 (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		61	(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)													
	3755.73	3143.04	2930.21	2031.41	1304.67	0	0	0	0	1940.49	2832.47	3721.58	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	6156.93	5152.53	4803.62	3330.19	2138.8	0	0	0	0	3181.13	4643.4	6100.96	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 35507.54 (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)

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DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

462.4	412.69	445.5	416.12	419.93	310.34	308.64	324.08	318.93	430.67	434.32	456.93

Efficiency of water heater 51 (216)

(217)m=	59.72	59.64	59.46	59.03	58.22	51	51	51	51	58.9	59.45	59.72	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	774.32	691.94	749.23	704.91	721.27	608.51	605.17	635.44	625.35	731.17	730.56	765.12

Total = Sum(219a)$_{1...12}$ = 8343 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			35507.54	
Water heating fuel used			8343	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)
Electricity for lighting			683.29	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	7669.63	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1802.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =				9471.72	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	104.32	(267)
Electricity for lighting	(232)	x	0.519	=	354.63	(268)
Total CO2, kg/year			sum of (265)…(271) =		9930.66	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		44.16	(273)
EI rating (section 14)					51	(274)

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SAP Input

Property Details: Flat 1

Address:
Located in: England
Region: Thames valley
UPRN:
Date of assessment: 28 October 2015
Date of certificate: 30 October 2015
Assessment type: New dwelling design stage
Transaction type: None of the above
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/person/day: True
PCDF Version: 383

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2015

Floor Location:	Floor area:	Storey height:
Basement floor	55.75 m²	3.1 m
Floor 1	156.34 m²	2.6 m
Floor 2	156.01 m²	3.28 m

Living area: 52.13 m² (fraction 0.142)
Front of dwelling faces: Unspecified

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
D2	Manufacturer	Half glazed	low-E, En = 0.2, hard coat	No	Metal
W1	SAP 2012	Windows	Single-glazed	No	
W2	SAP 2012	Windows	Single-glazed	No	Wood
W3	SAP 2012	Windows	Single-glazed	No	Wood
W4	SAP 2012	Windows	Single-glazed	No	Wood
W5	SAP 2012	Windows	Single-glazed	No	Wood
W6	SAP 2012	Windows	Single-glazed	No	Wood
W7	SAP 2012	Windows	Single-glazed	No	Wood
W8	SAP 2012	Windows	low-E, En = 0.2, hard coat	No	Wood
W09	SAP 2012	Windows	Single-glazed	No	Wood
w10	SAP 2012	Windows	Single-glazed	No	Wood
w11	SAP 2012	Windows	Single-glazed	No	Wood
w12	SAP 2012	Windows	Single-glazed	No	Wood
w13	SAP 2012	Windows	Single-glazed	No	Wood

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
D1	mm	0.7	0	2	2.1	1
D2	16mm or more mm	0.8	0.65	2	1.64	1
W1		0.7	0.85	4.5	1.5	2
W2		0.7	0.85	4.5	1.64	1
W3		0.7	0.85	4.5	1.64	1
W4		0.7	0.85	4.5	1.64	1
W5		0.7	0.85	4.5	1.64	1
W6		0.7	0.85	4.5	0.83	1
W7		0.7	0.85	4.5	1.64	1
W8	16mm or more	0.7	0.72	2.1	3.1	3

SAP Input

W09	0.7	0.85	4.8	5.13	1
w10	0.7	0.85	4.5	2.4	1
w11	0.7	0.85	4.5	2.4	1
w12	0.7	0.85	4.5	2.4	1
w13	0.7	0.85	4.5	2.83	3

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
D2		External wall GF	West	0.78	2.1
W1		External wall GF	South	1	1.5
W2		External wall GF	West	1.09	1.5
W3		External wall GF	South West	1.09	1.5
W4		External wall GF	West	1.09	1.5
W5		External wall GF	North West	1.09	1.5
W6		External wall GF	West	0.753	1.1
W7		External wall GF	South West	1.09	1.5
W8		External wall GF	North	1.24	2.5
W09		External FF	South	2.33	2.2
w10		External FF	South West	1.09	2.2
w11		External FF	West	1.09	2.2
w12		External FF	North West	1.09	2.2
w13		External FF	North	1.09	2.6

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Basement wall	87.11	0	87.11	0.45	0	False	N/A
External wall GF	101.74	22.97	78.77	0.45	0	False	N/A
corridor GF	43.34	0	43.34	0.45	0.9	False	N/A
Coprridor FF	53.64	0	53.64	0.45	0.9	False	N/A
External FF	119.93	20.82	99.11	0.45	0	False	N/A
internal	23.62	0	23.62	0.2	0		N/A
Basement floor	55.75			0.25			N/A
ground floor	100.58			0.25			N/A
internal floor	24.67			0.25			N/A
Internal Elements							
Party Elements							
party wall Basement	30.03						N/A
Party wall FF	25.87						N/A

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Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: No (Assumed)
Ventilation: Natural ventilation (extract fans)
Number of chimneys: 2 (main: 0, secondary: 1, other: 1)
Number of open flues: 0
Number of fans: 6
Number of passive stacks: 0
Number of sides sheltered: 4
Pressure test: 15

Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: SAP Tables

SAP Input

	SAP Table: 115 Wall mounted Systems with radiators Design flow temperature: Unknown Open Boiler interlock: Yes
Main heating Control:	
Main heating Control:	No time or thermostatic control of room temperature Control code: 2101
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas Hot water cylinder Cylinder volume: 250 litres Cylinder insulation: Factory 15 mm Primary pipework insulation: False Cylinderstat: False Cylinder in heated space: False Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.75	(1a)	x	3.1	(2a)	=	172.82	(3a)
Ground floor	156.34	(1b)	x	2.6	(2b)	=	406.48	(3b)
First floor	156.01	(1c)	x	3.28	(2c)	=	511.71	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	368.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1091.02	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	1	=	2	x 40 =	80	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							6	x 10 =	60	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	140	÷ (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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

SAP WorkSheet: New dwelling design stage

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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

0.78	0.77	0.75	0.68	0.66	0.58	0.58	0.57	0.61	0.66	0.69	0.72

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(24d)

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

(25)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x	2	=	4.2			(26)
Doors Type 2			1.64	x	2	=	3.28			(26)
Windows Type 1			1.5	x1/[1/(4.5)+ 0.04]		=	5.72			(27)
Windows Type 2			1.64	x1/[1/(4.5)+ 0.04]		=	6.25			(27)
Windows Type 3			1.64	x1/[1/(4.5)+ 0.04]		=	6.25			(27)
Windows Type 4			1.64	x1/[1/(4.5)+ 0.04]		=	6.25			(27)
Windows Type 5			1.64	x1/[1/(4.5)+ 0.04]		=	6.25			(27)
Windows Type 6			0.83	x1/[1/(4.5)+ 0.04]		=	3.17			(27)
Windows Type 7			1.64	x1/[1/(4.5)+ 0.04]		=	6.25			(27)
Windows Type 8			3.1	x1/[1/(2.1)+ 0.04]		=	6.01			(27)
Windows Type 9			5.13	x1/[1/(4.8)+ 0.04]		=	20.66			(27)
Windows Type 10			2.4	x1/[1/(4.5)+ 0.04]		=	9.15			(27)
Windows Type 11			2.4	x1/[1/(4.5)+ 0.04]		=	9.15			(27)
Windows Type 12			2.4	x1/[1/(4.5)+ 0.04]		=	9.15			(27)
Windows Type 13			2.83	x1/[1/(4.5)+ 0.04]		=	10.79			(27)
Floor Type 1			55.75	x	0.25	=	13.9375			(28)
Floor Type 2			100.58	x	0.25	=	25.145			(28)

SAP WorkSheet: New dwelling design stage

Floor Type 3			24.67	x	0.25	=	6.1675			(28)
Walls Type1	87.11	0	87.11	x	0.45	=	39.2			(29)
Walls Type2	101.74	22.97	78.77	x	0.45	=	35.45			(29)
Walls Type3	43.34	0	43.34	x	0.32	=	13.88			(29)
Walls Type4	53.64	0	53.64	x	0.32	=	17.18			(29)
Walls Type5	119.93	20.82	99.11	x	0.45	=	44.6			(29)
Roof	23.62	0	23.62	x	0.2	=	4.72			(30)
Total area of elements, m²			612.48							(31)
Party wall			30.03	x	0	=	0			(32)
Party wall			25.87	x	0	=	0			(32)

** 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) = 352.15 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 91.87 (36)

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

Total fabric heat loss (33) + (36) = 444.02 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	290.64	286.34	282.13	262.36	258.66	241.43	241.43	238.24	248.07	258.66	266.14	273.97	(38)

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

(39)m=	734.66	730.36	726.15	706.38	702.68	685.45	685.45	682.26	692.09	702.68	710.16	717.99	

Average = $Sum(39)_{1…12}$ /12= 706.36 (39)

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

(40)m=	2	1.98	1.97	1.92	1.91	1.86	1.86	1.85	1.88	1.91	1.93	1.95	

Average = $Sum(40)_{1…12}$ /12= 1.92 (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 3.22 (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) + 36 110.69 (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=	121.75	117.33	112.9	108.47	104.04	99.62	99.62	104.04	108.47	112.9	117.33	121.75

Total = $Sum(44)_{1…12}$ = 1328.23 (44)

SAP WorkSheet: New dwelling design stage

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=	180.56	157.92	162.96	142.07	136.32	117.63	109	125.08	126.58	147.51	161.02	174.86

Total = Sum(45)$_{1...12}$ = 1741.52 (45)

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

(46)m=	27.08	23.69	24.44	21.31	20.45	17.64	16.35	18.76	18.99	22.13	24.15	26.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 250 (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) = 250 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.03 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0.78 (52)

Temperature factor from Table 2b — 0.78 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 5.18 (54)

Enter (50) or (54) in (55) — 5.18 (55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	469.61	419	452.01	421.8	425.37	315.04	312.99	329.07	323.99	436.57	440.75	463.91	(62)

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

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

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

Output from water heater

(64)m=	469.61	419	452.01	421.8	425.37	315.04	312.99	329.07	323.99	436.57	440.75	463.91

Output from water heater (annual)$_{1...12}$ — 4810.11 (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=	162.74	145.27	156.88	146.63	148.03	72.65	70.89	76.24	75.62	151.75	152.93	160.84	(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

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(66)m=	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	128.45	114.09	92.78	70.24	52.51	44.33	47.9	62.26	83.57	106.11	123.84	132.02	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	763.18	771.1	751.15	708.66	655.03	604.63	570.95	563.03	582.99	625.47	679.11	729.51	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	(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=	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	(71)
Water heating gains (Table 5)													
(72)m=	218.73	216.18	210.87	203.65	198.96	100.9	95.29	102.47	105.03	203.97	212.4	216.19	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	1232.32	1223.32	1176.75	1104.51	1028.45	871.8	836.09	849.72	893.54	1057.5	1137.3	1199.67	(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)	
North	0.9x	0.54	x	3.1	x	10.63	x	0.72	x	0.7	=	24.22	(74)
North	0.9x	0.54	x	2.83	x	10.63	x	0.85	x	0.7	=	26.11	(74)
North	0.9x	0.54	x	3.1	x	20.32	x	0.72	x	0.7	=	46.29	(74)
North	0.9x	0.54	x	2.83	x	20.32	x	0.85	x	0.7	=	49.89	(74)
North	0.9x	0.54	x	3.1	x	34.53	x	0.72	x	0.7	=	78.66	(74)
North	0.9x	0.54	x	2.83	x	34.53	x	0.85	x	0.7	=	84.77	(74)
North	0.9x	0.54	x	3.1	x	55.46	x	0.72	x	0.7	=	126.35	(74)
North	0.9x	0.54	x	2.83	x	55.46	x	0.85	x	0.7	=	136.17	(74)
North	0.9x	0.54	x	3.1	x	74.72	x	0.72	x	0.7	=	170.2	(74)
North	0.9x	0.54	x	2.83	x	74.72	x	0.85	x	0.7	=	183.43	(74)
North	0.9x	0.54	x	3.1	x	79.99	x	0.72	x	0.7	=	182.2	(74)
North	0.9x	0.54	x	2.83	x	79.99	x	0.85	x	0.7	=	196.37	(74)
North	0.9x	0.54	x	3.1	x	74.68	x	0.72	x	0.7	=	170.11	(74)
North	0.9x	0.54	x	2.83	x	74.68	x	0.85	x	0.7	=	183.33	(74)
North	0.9x	0.54	x	3.1	x	59.25	x	0.72	x	0.7	=	134.96	(74)
North	0.9x	0.54	x	2.83	x	59.25	x	0.85	x	0.7	=	145.45	(74)
North	0.9x	0.54	x	3.1	x	41.52	x	0.72	x	0.7	=	94.57	(74)
North	0.9x	0.54	x	2.83	x	41.52	x	0.85	x	0.7	=	101.93	(74)
North	0.9x	0.54	x	3.1	x	24.19	x	0.72	x	0.7	=	55.1	(74)
North	0.9x	0.54	x	2.83	x	24.19	x	0.85	x	0.7	=	59.39	(74)
North	0.9x	0.54	x	3.1	x	13.12	x	0.72	x	0.7	=	29.88	(74)

SAP WorkSheet: New dwelling design stage

North	0.9x	0.54	x	2.83	x	13.12	x	0.85	x	0.7	=	32.2	(74)
North	0.9x	0.54	x	3.1	x	8.86	x	0.72	x	0.7	=	20.19	(74)
North	0.9x	0.54	x	2.83	x	8.86	x	0.85	x	0.7	=	21.76	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	22.53	(78)
South	0.9x	1	x	5.13	x	46.75	x	0.85	x	0.7	=	128.43	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	36.9	(78)
South	0.9x	1	x	5.13	x	76.57	x	0.85	x	0.7	=	210.34	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	47.01	(78)
South	0.9x	1	x	5.13	x	97.53	x	0.85	x	0.7	=	267.94	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	53.13	(78)
South	0.9x	1	x	5.13	x	110.23	x	0.85	x	0.7	=	302.83	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	55.36	(78)
South	0.9x	1	x	5.13	x	114.87	x	0.85	x	0.7	=	315.56	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	53.28	(78)
South	0.9x	1	x	5.13	x	110.55	x	0.85	x	0.7	=	303.69	(78)
South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	52.06	(78)
South	0.9x	1	x	5.13	x	108.01	x	0.85	x	0.7	=	296.72	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	50.55	(78)
South	0.9x	1	x	5.13	x	104.89	x	0.85	x	0.7	=	288.16	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	49.1	(78)
South	0.9x	1	x	5.13	x	101.89	x	0.85	x	0.7	=	279.89	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	39.8	(78)
South	0.9x	1	x	5.13	x	82.59	x	0.85	x	0.7	=	226.87	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	26.71	(78)
South	0.9x	1	x	5.13	x	55.42	x	0.85	x	0.7	=	152.24	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	19.47	(78)
South	0.9x	1	x	5.13	x	40.4	x	0.85	x	0.7	=	110.98	(78)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	2.4	x	36.79		0.85	x	0.7	=	25.54	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	2.4	x	62.67		0.85	x	0.7	=	43.5	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	2.4	x	85.75		0.85	x	0.7	=	59.51	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	2.4	x	106.25		0.85	x	0.7	=	73.74	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)

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Southwest	0.9x	0.54	x	2.4	x	119.01		0.85	x	0.7	=	82.59	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	2.4	x	118.15		0.85	x	0.7	=	82	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	2.4	x	113.91		0.85	x	0.7	=	79.05	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	2.4	x	104.39		0.85	x	0.7	=	72.45	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	2.4	x	92.85		0.85	x	0.7	=	64.44	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	2.4	x	69.27		0.85	x	0.7	=	48.07	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	2.4	x	44.07		0.85	x	0.7	=	30.59	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	2.4	x	31.49		0.85	x	0.7	=	21.85	(79)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	0.83	x	19.64	x	0.85	x	0.7	=	4.71	(80)
West	0.9x	0.54	x	2.4	x	19.64	x	0.85	x	0.7	=	13.63	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	0.83	x	38.42	x	0.85	x	0.7	=	9.22	(80)
West	0.9x	0.54	x	2.4	x	38.42	x	0.85	x	0.7	=	26.66	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	0.83	x	63.27	x	0.85	x	0.7	=	15.19	(80)
West	0.9x	0.54	x	2.4	x	63.27	x	0.85	x	0.7	=	43.91	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	0.83	x	92.28	x	0.85	x	0.7	=	22.15	(80)
West	0.9x	0.54	x	2.4	x	92.28	x	0.85	x	0.7	=	64.04	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	0.83	x	113.09	x	0.85	x	0.7	=	27.14	(80)

SAP WorkSheet: New dwelling design stage

West	0.9x	0.54	x	2.4	x	113.09	x	0.85	x	0.7	=	78.49	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	0.83	x	115.77	x	0.85	x	0.7	=	27.79	(80)
West	0.9x	0.54	x	2.4	x	115.77	x	0.85	x	0.7	=	80.35	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	0.83	x	110.22	x	0.85	x	0.7	=	26.45	(80)
West	0.9x	0.54	x	2.4	x	110.22	x	0.85	x	0.7	=	76.49	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	0.83	x	94.68	x	0.85	x	0.7	=	22.72	(80)
West	0.9x	0.54	x	2.4	x	94.68	x	0.85	x	0.7	=	65.71	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	0.83	x	73.59	x	0.85	x	0.7	=	17.66	(80)
West	0.9x	0.54	x	2.4	x	73.59	x	0.85	x	0.7	=	51.07	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	0.83	x	45.59	x	0.85	x	0.7	=	10.94	(80)
West	0.9x	0.54	x	2.4	x	45.59	x	0.85	x	0.7	=	31.64	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	0.83	x	24.49	x	0.85	x	0.7	=	5.88	(80)
West	0.9x	0.54	x	2.4	x	24.49	x	0.85	x	0.7	=	17	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	0.83	x	16.15	x	0.85	x	0.7	=	3.88	(80)
West	0.9x	0.54	x	2.4	x	16.15	x	0.85	x	0.7	=	11.21	(80)
Northwest	0.9x	0.54	x	1.64	x	11.28	x	0.85	x	0.7	=	5.35	(81)
Northwest	0.9x	0.54	x	2.4	x	11.28	x	0.85	x	0.7	=	7.83	(81)
Northwest	0.9x	0.54	x	1.64	x	22.97	x	0.85	x	0.7	=	10.89	(81)
Northwest	0.9x	0.54	x	2.4	x	22.97	x	0.85	x	0.7	=	15.94	(81)
Northwest	0.9x	0.54	x	1.64	x	41.38	x	0.85	x	0.7	=	19.62	(81)
Northwest	0.9x	0.54	x	2.4	x	41.38	x	0.85	x	0.7	=	28.72	(81)
Northwest	0.9x	0.54	x	1.64	x	67.96	x	0.85	x	0.7	=	32.23	(81)
Northwest	0.9x	0.54	x	2.4	x	67.96	x	0.85	x	0.7	=	47.16	(81)
Northwest	0.9x	0.54	x	1.64	x	91.35	x	0.85	x	0.7	=	43.32	(81)
Northwest	0.9x	0.54	x	2.4	x	91.35	x	0.85	x	0.7	=	63.39	(81)
Northwest	0.9x	0.54	x	1.64	x	97.38	x	0.85	x	0.7	=	46.18	(81)
Northwest	0.9x	0.54	x	2.4	x	97.38	x	0.85	x	0.7	=	67.59	(81)

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SAP WorkSheet: New dwelling design stage

Northwest	0.9x	0.54	x	1.64	x	91.1	x	0.85	x	0.7	=	43.2	(81)
Northwest	0.9x	0.54	x	2.4	x	91.1	x	0.85	x	0.7	=	63.22	(81)
Northwest	0.9x	0.54	x	1.64	x	72.63	x	0.85	x	0.7	=	34.44	(81)
Northwest	0.9x	0.54	x	2.4	x	72.63	x	0.85	x	0.7	=	50.4	(81)
Northwest	0.9x	0.54	x	1.64	x	50.42	x	0.85	x	0.7	=	23.91	(81)
Northwest	0.9x	0.54	x	2.4	x	50.42	x	0.85	x	0.7	=	34.99	(81)
Northwest	0.9x	0.54	x	1.64	x	28.07	x	0.85	x	0.7	=	13.31	(81)
Northwest	0.9x	0.54	x	2.4	x	28.07	x	0.85	x	0.7	=	19.48	(81)
Northwest	0.9x	0.54	x	1.64	x	14.2	x	0.85	x	0.7	=	6.73	(81)
Northwest	0.9x	0.54	x	2.4	x	14.2	x	0.85	x	0.7	=	9.85	(81)
Northwest	0.9x	0.54	x	1.64	x	9.21	x	0.85	x	0.7	=	4.37	(81)
Northwest	0.9x	0.54	x	2.4	x	9.21	x	0.85	x	0.7	=	6.39	(81)

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

(83)m=	311.88	545.52	786.68	1046.09	1239.64	1261.31	1203.23	1053.66	875.44	613.55	376.1	265.29	(83)

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

(84)m=	1544.2	1768.84	1963.42	2150.6	2268.1	2133.11	2039.32	1903.38	1768.97	1671.05	1513.4	1464.96	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.96	0.9	0.92	0.98	1	1	1	(86)

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

(87)m=	18.63	18.79	19.1	19.57	20.03	20.47	20.73	20.69	20.31	19.73	19.13	18.64	(87)

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

(88)m=	20	20.01	20.01	20.04	20.05	20.07	20.07	20.07	20.06	20.05	20.04	20.02	(88)

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

(89)m=	1	1	1	0.99	0.98	0.93	0.83	0.87	0.97	0.99	1	1	(89)

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

(90)m=	17.79	17.96	18.27	18.76	19.23	19.67	19.92	19.88	19.52	18.93	18.32	17.82	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	17.91	18.07	18.39	18.87	19.34	19.79	20.03	20	19.63	19.04	18.44	17.94	(92)

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

(93)m=	18.51	18.67	18.99	19.47	19.94	20.39	20.63	20.6	20.23	19.64	19.04	18.54	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.98	0.94	0.88	0.9	0.97	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1541.89	1764.4	1954.23	2128.62	2211.56	2012.14	1790.32	1721.29	1718.05	1658.32	1509.85	1463.21	(95)

SAP WorkSheet: New dwelling design stage

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=	10440.38	10059.16	9067.87	7467.12	5791.16	3965.63	2763.21	2862.39	4242.48	6354.9	8476.07	10293.59	(97)

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

(98)m=	6620.48	5574.08	5292.55	3843.72	2663.22	0	0	0	0	3494.25	5015.68	6569.8	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 39073.78 (98)

Space heating requirement in kWh/m²/year 106.15 (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		61	(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)	6620.48	5574.08	5292.55	3843.72	2663.22	0	0	0	0	3494.25	5015.68	6569.8		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	10853.24	9137.83	8676.31	6301.19	4365.94	0	0	0	0	5728.28	8222.42	10770.16		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													64055.38	(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)	469.61	419	452.01	421.8	425.37	315.04	312.99	329.07	323.99	436.57	440.75	463.91		
Efficiency of water heater													51	(216)
(217)m=	60.22	60.18	60.07	59.84	59.4	51	51	51	51	59.7	60.05	60.22		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	779.85	696.3	752.43	704.88	716.16	617.73	613.71	645.24	635.27	731.27	733.99	770.35		
Total = Sum(219a)$_{1...12}$ =													8397.18	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			64055.38	
Water heating fuel used			8397.18	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)

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SAP WorkSheet: New dwelling design stage

Electricity for lighting				907.39	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	2229.13	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	292.22	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	26.51	(249)

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

Energy for lighting	(232)		13.19	x 0.01 =	119.68	(250)
Additional standing charges (Table 12)					120	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	2787.55	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.83	(257)
SAP rating (Section 12)		60.46	(258)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating (main system 1)	(211)	x	0.216	=	13835.96	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1813.79	(264)
Space and water heating	(261) + (262) + (263) + (264) =				15649.75	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	104.32	(267)
Electricity for lighting	(232)	x	0.519	=	470.94	(268)
Total CO_2, kg/year			sum of (265)…(271) =		16225.01	(272)
CO_2 emissions per m²			(272) ÷ (4) =		44.08	(273)
EI rating (section 14)					49	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	78147.56	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	10244.56	(264)

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SAP WorkSheet: New dwelling design stage

Space and water heating	(261) + (262) + (263) + (264) =			88392.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	617.07	(267)
Electricity for lighting	(232) x	0	=	2785.69	(268)
'Total Primary Energy		sum of (265)…(271) =		91794.88	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		249.37	(273)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.75	(1a)	x	3.1	(2a)	=	172.82	(3a)
Ground floor	156.34	(1b)	x	2.6	(2b)	=	406.48	(3b)
First floor	156.01	(1c)	x	3.28	(2c)	=	511.71	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	368.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			1091.02	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	1	=	2	x 40 =	80	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							6	x 10 =	60	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	140	÷ (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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

DER WorkSheet: New dwelling design stage

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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

0.78	0.77	0.75	0.68	0.66	0.58	0.58	0.57	0.61	0.66	0.69	0.72

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(24d)

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

(25)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x	2	=	4.2			(26)
Doors Type 2			1.64	x	2	=	3.28			(26)
Windows Type 1			1.5		x1/[1/(4.5)+ 0.04]	=	5.72			(27)
Windows Type 2			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 3			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 4			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 5			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 6			0.83		x1/[1/(4.5)+ 0.04]	=	3.17			(27)
Windows Type 7			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 8			3.1		x1/[1/(2.1)+ 0.04]	=	6.01			(27)
Windows Type 9			5.13		x1/[1/(4.8)+ 0.04]	=	20.66			(27)
Windows Type 10			2.4		x1/[1/(4.5)+ 0.04]	=	9.15			(27)
Windows Type 11			2.4		x1/[1/(4.5)+ 0.04]	=	9.15			(27)
Windows Type 12			2.4		x1/[1/(4.5)+ 0.04]	=	9.15			(27)
Windows Type 13			2.83		x1/[1/(4.5)+ 0.04]	=	10.79			(27)
Floor Type 1			55.75	x	0.25	=	13.9375			(28)
Floor Type 2			100.58	x	0.25	=	25.145			(28)

DER WorkSheet: New dwelling design stage

Floor Type 3			24.67	x	0.25	=	6.1675			(28)
Walls Type1	87.11	0	87.11	x	0.45	=	39.2			(29)
Walls Type2	101.74	22.97	78.77	x	0.45	=	35.45			(29)
Walls Type3	43.34	0	43.34	x	0.32	=	13.88			(29)
Walls Type4	53.64	0	53.64	x	0.32	=	17.18			(29)
Walls Type5	119.93	20.82	99.11	x	0.45	=	44.6			(29)
Roof	23.62	0	23.62	x	0.2	=	4.72			(30)
Total area of elements, m²			612.48							(31)
Party wall			30.03	x	0	=	0			(32)
Party wall			25.87	x	0	=	0			(32)

** 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) = 352.15 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 91.87 (36)

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

Total fabric heat loss (33) + (36) = 444.02 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	290.64	286.34	282.13	262.36	258.66	241.43	241.43	238.24	248.07	258.66	266.14	273.97	(38)

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

(39)m=	734.66	730.36	726.15	706.38	702.68	685.45	685.45	682.26	692.09	702.68	710.16	717.99	

Average = Sum(39)$_{1…12}$ /12= 706.36 (39)

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

(40)m=	2	1.98	1.97	1.92	1.91	1.86	1.86	1.85	1.88	1.91	1.93	1.95	

Average = Sum(40)$_{1…12}$ /12= 1.92 (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 3.22 (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) + 36 110.69 (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
(44)m=	121.75	117.33	112.9	108.47	104.04	99.62	99.62	104.04	108.47	112.9	117.33	121.75

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

Total = Sum(44)$_{1…12}$ = 1328.23 (44)

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DER WorkSheet: New dwelling design stage

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=	180.56	157.92	162.96	142.07	136.32	117.63	109	125.08	126.58	147.51	161.02	174.86

Total = Sum(45)$_{1...12}$ = 1741.52 (45)

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

(46)m=	27.08	23.69	24.44	21.31	20.45	17.64	16.35	18.76	18.99	22.13	24.15	26.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		250	(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) =	250	(50)
b) If manufacturer’s declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.03	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.78	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	5.18	(54)
Enter (50) or (54) in (55)		5.18	(55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	469.61	419	452.01	421.8	425.37	315.04	312.99	329.07	323.99	436.57	440.75	463.91	(62)

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

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

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

Output from water heater

(64)m=	469.61	419	452.01	421.8	425.37	315.04	312.99	329.07	323.99	436.57	440.75	463.91

Output from water heater (annual)$_{1...12}$ 4810.11 (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=	162.74	145.27	156.88	146.63	148.03	72.65	70.89	76.24	75.62	151.75	152.93	160.84	(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

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(66)m=	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	(66)

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

(67)m=	51.71	45.93	37.35	28.28	21.14	17.84	19.28	25.06	33.64	42.71	49.85	53.14	(67)

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

(68)m=	511.33	516.64	503.27	474.8	438.87	405.1	382.54	377.23	390.6	419.07	455	488.77	(68)

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

(69)m=	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	(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=	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	(71)

Water heating gains (Table 5)

(72)m=	218.73	216.18	210.87	203.65	198.96	100.9	95.29	102.47	105.03	203.97	212.4	216.19	(72)

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

(73)m=	853.08	850.05	822.79	778.03	730.28	595.15	568.41	576.08	600.58	737.05	788.56	829.41	(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	0.54	x	3.1	x	10.63	x	0.72	x	0.7	=	24.22	(74)
North	0.9x	0.54	x	2.83	x	10.63	x	0.85	x	0.7	=	26.11	(74)
North	0.9x	0.54	x	3.1	x	20.32	x	0.72	x	0.7	=	46.29	(74)
North	0.9x	0.54	x	2.83	x	20.32	x	0.85	x	0.7	=	49.89	(74)
North	0.9x	0.54	x	3.1	x	34.53	x	0.72	x	0.7	=	78.66	(74)
North	0.9x	0.54	x	2.83	x	34.53	x	0.85	x	0.7	=	84.77	(74)
North	0.9x	0.54	x	3.1	x	55.46	x	0.72	x	0.7	=	126.35	(74)
North	0.9x	0.54	x	2.83	x	55.46	x	0.85	x	0.7	=	136.17	(74)
North	0.9x	0.54	x	3.1	x	74.72	x	0.72	x	0.7	=	170.2	(74)
North	0.9x	0.54	x	2.83	x	74.72	x	0.85	x	0.7	=	183.43	(74)
North	0.9x	0.54	x	3.1	x	79.99	x	0.72	x	0.7	=	182.2	(74)
North	0.9x	0.54	x	2.83	x	79.99	x	0.85	x	0.7	=	196.37	(74)
North	0.9x	0.54	x	3.1	x	74.68	x	0.72	x	0.7	=	170.11	(74)
North	0.9x	0.54	x	2.83	x	74.68	x	0.85	x	0.7	=	183.33	(74)
North	0.9x	0.54	x	3.1	x	59.25	x	0.72	x	0.7	=	134.96	(74)
North	0.9x	0.54	x	2.83	x	59.25	x	0.85	x	0.7	=	145.45	(74)
North	0.9x	0.54	x	3.1	x	41.52	x	0.72	x	0.7	=	94.57	(74)
North	0.9x	0.54	x	2.83	x	41.52	x	0.85	x	0.7	=	101.93	(74)
North	0.9x	0.54	x	3.1	x	24.19	x	0.72	x	0.7	=	55.1	(74)
North	0.9x	0.54	x	2.83	x	24.19	x	0.85	x	0.7	=	59.39	(74)
North	0.9x	0.54	x	3.1	x	13.12	x	0.72	x	0.7	=	29.88	(74)

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DER WorkSheet: New dwelling design stage

North	0.9x	0.54	x	2.83	x	13.12	x	0.85	x	0.7	=	32.2	(74)
North	0.9x	0.54	x	3.1	x	8.86	x	0.72	x	0.7	=	20.19	(74)
North	0.9x	0.54	x	2.83	x	8.86	x	0.85	x	0.7	=	21.76	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	22.53	(78)
South	0.9x	0.77	x	5.13	x	46.75	x	0.85	x	0.7	=	98.89	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	36.9	(78)
South	0.9x	0.77	x	5.13	x	76.57	x	0.85	x	0.7	=	161.96	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	47.01	(78)
South	0.9x	0.77	x	5.13	x	97.53	x	0.85	x	0.7	=	206.31	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	53.13	(78)
South	0.9x	0.77	x	5.13	x	110.23	x	0.85	x	0.7	=	233.18	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	55.36	(78)
South	0.9x	0.77	x	5.13	x	114.87	x	0.85	x	0.7	=	242.98	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	53.28	(78)
South	0.9x	0.77	x	5.13	x	110.55	x	0.85	x	0.7	=	233.84	(78)
South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	52.06	(78)
South	0.9x	0.77	x	5.13	x	108.01	x	0.85	x	0.7	=	228.48	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	5.13	x	104.89	x	0.85	x	0.7	=	221.88	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	49.1	(78)
South	0.9x	0.77	x	5.13	x	101.89	x	0.85	x	0.7	=	215.52	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	39.8	(78)
South	0.9x	0.77	x	5.13	x	82.59	x	0.85	x	0.7	=	174.69	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	26.71	(78)
South	0.9x	0.77	x	5.13	x	55.42	x	0.85	x	0.7	=	117.22	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	19.47	(78)
South	0.9x	0.77	x	5.13	x	40.4	x	0.85	x	0.7	=	85.45	(78)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	2.4	x	36.79		0.85	x	0.7	=	25.54	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	2.4	x	62.67		0.85	x	0.7	=	43.5	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	2.4	x	85.75		0.85	x	0.7	=	59.51	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	2.4	x	106.25		0.85	x	0.7	=	73.74	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)

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DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.54	x	2.4	x	119.01		0.85	x	0.7	=	82.59	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	2.4	x	118.15		0.85	x	0.7	=	82	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	2.4	x	113.91		0.85	x	0.7	=	79.05	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	2.4	x	104.39		0.85	x	0.7	=	72.45	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	2.4	x	92.85		0.85	x	0.7	=	64.44	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	2.4	x	69.27		0.85	x	0.7	=	48.07	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	2.4	x	44.07		0.85	x	0.7	=	30.59	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	2.4	x	31.49		0.85	x	0.7	=	21.85	(79)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	0.83	x	19.64	x	0.85	x	0.7	=	4.71	(80)
West	0.9x	0.54	x	2.4	x	19.64	x	0.85	x	0.7	=	13.63	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	0.83	x	38.42	x	0.85	x	0.7	=	9.22	(80)
West	0.9x	0.54	x	2.4	x	38.42	x	0.85	x	0.7	=	26.66	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	0.83	x	63.27	x	0.85	x	0.7	=	15.19	(80)
West	0.9x	0.54	x	2.4	x	63.27	x	0.85	x	0.7	=	43.91	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	0.83	x	92.28	x	0.85	x	0.7	=	22.15	(80)
West	0.9x	0.54	x	2.4	x	92.28	x	0.85	x	0.7	=	64.04	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	0.83	x	113.09	x	0.85	x	0.7	=	27.14	(80)

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DER WorkSheet: New dwelling design stage

West	0.9x	0.54	x	2.4	x	113.09	x	0.85	x	0.7	=	78.49	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	0.83	x	115.77	x	0.85	x	0.7	=	27.79	(80)
West	0.9x	0.54	x	2.4	x	115.77	x	0.85	x	0.7	=	80.35	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	0.83	x	110.22	x	0.85	x	0.7	=	26.45	(80)
West	0.9x	0.54	x	2.4	x	110.22	x	0.85	x	0.7	=	76.49	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	0.83	x	94.68	x	0.85	x	0.7	=	22.72	(80)
West	0.9x	0.54	x	2.4	x	94.68	x	0.85	x	0.7	=	65.71	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	0.83	x	73.59	x	0.85	x	0.7	=	17.66	(80)
West	0.9x	0.54	x	2.4	x	73.59	x	0.85	x	0.7	=	51.07	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	0.83	x	45.59	x	0.85	x	0.7	=	10.94	(80)
West	0.9x	0.54	x	2.4	x	45.59	x	0.85	x	0.7	=	31.64	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	0.83	x	24.49	x	0.85	x	0.7	=	5.88	(80)
West	0.9x	0.54	x	2.4	x	24.49	x	0.85	x	0.7	=	17	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	0.83	x	16.15	x	0.85	x	0.7	=	3.88	(80)
West	0.9x	0.54	x	2.4	x	16.15	x	0.85	x	0.7	=	11.21	(80)
Northwest	0.9x	0.54	x	1.64	x	11.28	x	0.85	x	0.7	=	5.35	(81)
Northwest	0.9x	0.54	x	2.4	x	11.28	x	0.85	x	0.7	=	7.83	(81)
Northwest	0.9x	0.54	x	1.64	x	22.97	x	0.85	x	0.7	=	10.89	(81)
Northwest	0.9x	0.54	x	2.4	x	22.97	x	0.85	x	0.7	=	15.94	(81)
Northwest	0.9x	0.54	x	1.64	x	41.38	x	0.85	x	0.7	=	19.62	(81)
Northwest	0.9x	0.54	x	2.4	x	41.38	x	0.85	x	0.7	=	28.72	(81)
Northwest	0.9x	0.54	x	1.64	x	67.96	x	0.85	x	0.7	=	32.23	(81)
Northwest	0.9x	0.54	x	2.4	x	67.96	x	0.85	x	0.7	=	47.16	(81)
Northwest	0.9x	0.54	x	1.64	x	91.35	x	0.85	x	0.7	=	43.32	(81)
Northwest	0.9x	0.54	x	2.4	x	91.35	x	0.85	x	0.7	=	63.39	(81)
Northwest	0.9x	0.54	x	1.64	x	97.38	x	0.85	x	0.7	=	46.18	(81)
Northwest	0.9x	0.54	x	2.4	x	97.38	x	0.85	x	0.7	=	67.59	(81)

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DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.54	x	1.64	x	91.1	x	0.85	x	0.7	=	43.2	(81)
Northwest	0.9x	0.54	x	2.4	x	91.1	x	0.85	x	0.7	=	63.22	(81)
Northwest	0.9x	0.54	x	1.64	x	72.63	x	0.85	x	0.7	=	34.44	(81)
Northwest	0.9x	0.54	x	2.4	x	72.63	x	0.85	x	0.7	=	50.4	(81)
Northwest	0.9x	0.54	x	1.64	x	50.42	x	0.85	x	0.7	=	23.91	(81)
Northwest	0.9x	0.54	x	2.4	x	50.42	x	0.85	x	0.7	=	34.99	(81)
Northwest	0.9x	0.54	x	1.64	x	28.07	x	0.85	x	0.7	=	13.31	(81)
Northwest	0.9x	0.54	x	2.4	x	28.07	x	0.85	x	0.7	=	19.48	(81)
Northwest	0.9x	0.54	x	1.64	x	14.2	x	0.85	x	0.7	=	6.73	(81)
Northwest	0.9x	0.54	x	2.4	x	14.2	x	0.85	x	0.7	=	9.85	(81)
Northwest	0.9x	0.54	x	1.64	x	9.21	x	0.85	x	0.7	=	4.37	(81)
Northwest	0.9x	0.54	x	2.4	x	9.21	x	0.85	x	0.7	=	6.39	(81)

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

(83)m=	282.34	497.14	725.05	976.44	1167.06	1191.46	1134.99	987.38	811.06	561.36	341.09	239.77	(83)

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

(84)m=	1135.42	1347.19	1547.84	1754.48	1897.34	1786.61	1703.4	1563.46	1411.64	1298.42	1129.65	1069.18	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	0.99	0.97	0.94	0.95	0.99	1	1	1	(86)

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

(87)m=	18.54	18.69	19.01	19.48	19.96	20.4	20.68	20.63	20.24	19.65	19.05	18.55	(87)

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

(88)m=	20	20.01	20.01	20.04	20.05	20.07	20.07	20.07	20.06	20.05	20.04	20.02	(88)

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

(89)m=	1	1	1	1	0.99	0.96	0.89	0.92	0.98	1	1	1	(89)

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

(90)m=	17.7	17.86	18.18	18.67	19.15	19.61	19.87	19.83	19.44	18.85	18.24	17.73	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	17.82	17.98	18.3	18.78	19.26	19.72	19.99	19.94	19.56	18.96	18.35	17.85	(92)

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

(93)m=	18.42	18.58	18.9	19.38	19.86	20.32	20.59	20.54	20.16	19.56	18.95	18.45	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.98	0.96	0.92	0.94	0.98	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1134.77	1345.72	1544.3	1744.63	1868.43	1721.96	1563.08	1468.87	1389.85	1293.8	1128.59	1068.71	(95)

DER WorkSheet: New dwelling design stage

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=	10374.18	9991.3	9001.62	7406.13	5736.93	3921.84	2732.78	2827.2	4191.58	6297.3	8415.48	10230.46	(97)

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

(98)m=	6874.12	5809.83	5548.24	4076.28	2878.16	0	0	0	0	3722.61	5246.56	6816.34

Total per year (kWh/year) = Sum(98)1...5,9...12 = 40972.15 (98)

Space heating requirement in kWh/m²/year 111.31 (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 61 (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)	6874.12	5809.83	5548.24	4076.28	2878.16	0	0	0	0	3722.61	5246.56	6816.34	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	11269.06	9524.31	9095.48	6682.42	4718.3	0	0	0	0	6102.63	8600.92	11174.33	(211)

Total (kWh/year) =Sum(211)1...5,10....12= 67167.45 (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)

469.61	419	452.01	421.8	425.37	315.04	312.99	329.07	323.99	436.57	440.75	463.91

Efficiency of water heater 51 (216)

(217)m=	60.24	60.21	60.11	59.9	59.5	51	51	51	51	59.77	60.09	60.25	(217)

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

(219)m=	779.51	695.94	751.94	704.19	714.94	617.73	613.71	645.24	635.27	730.41	733.52	770.02

Total = Sum(219a)1...12 = 8392.42 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		67167.45	
Water heating fuel used		8392.42	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	156		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		201	(231)

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Electricity for lighting	913.16	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	14508.17	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1812.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =				16320.93	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	104.32	(267)
Electricity for lighting	(232)	x	0.519	=	473.93	(268)
Total CO2, kg/year			sum of (265)…(271) =		16899.18	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		45.91	(273)
El rating (section 14)					47	(274)

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SAP Input

Property Details: Flat 5

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2015

Floor Location:	Floor area:	Storey height:
Floor 0	91.6 m²	3.28 m
Floor 1	84.96 m²	2.65 m

Living area:	54.11 m² (fraction 0.591)
Front of dwelling faces:	Unspecified

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
d2	Manufacturer	Half glazed	low-E, En = 0.2, hard coat	No	Wood
W1	Manufacturer	Windows	Single-glazed	No	Wood
W2	Manufacturer	Windows	Single-glazed	No	
W3	Manufacturer	Windows	Single-glazed	No	
W4	Manufacturer	Windows	Single-glazed	No	
w5	Manufacturer	Windows	Single-glazed	No	
W6	Manufacturer	Windows	Single-glazed	No	
w7	Manufacturer	Windows	Single-glazed	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
d2	16mm or more mm	0.7	0.65	2	2.06	1
W1		0.7	0.65	4.5	1.93	2
W2	16mm or more	0.7	0.65	4.5	1.8	4
W3	16mm or more	0.7	0.65	4.5	1.8	3
W4	16mm or more	0.7	0.65	4.5	1.84	2
w5	16mm or more	0.7	0.65	4.5	1.43	3
W6	16mm or more	0.7	0.65	4.5	1.43	2
w7	16mm or more	0.7	0.65	4.5	1.43	3
RF1	16mm or more	0.7	0.65	4.5	1.2	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
d2		External wall GF	South	0.98	2.1
W1		External wall GF	South	0.963	2
W2		External wall GF	South	1	1.8
W3		External wall GF	East	1	1.8

SAP Input

W4	External wall GF	North	1.02	1.8
w5	External wall GF	North	1.02	1.4
W6	External wall GF	East	1.02	1.4
w7	External wall GF	South	1.02	1.4
RF1	Flat roof 2	Horizontal	1.518	0.792

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External wall GF	110.667	33.64	77.03	0.45	0	False	N/A
corridor GF	21.14	0	21.14	0.25	0.9	False	N/A
External FF	48.075	0	48.08	0.45	0	False	N/A
flat roof 1	39.87	0	39.87	0.2	0		N/A
Flat roof 2	84.96	1.2	83.76	0.2	0		N/A
above garage	68.67			0.25			N/A
Internal Elements							
Party Elements							
party GF	71.63						N/A
Party wall FF	118.11						N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	No (Assumed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	1 (main: 0, secondary: 0, other: 1)
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	15

Main heating system:

Main heating system:
Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: SAP Tables
SAP Table: 115
Wall mounted
Systems with radiators
Design flow temperature: Unknown
Open
Boiler interlock: Yes

Main heating Control:

Main heating Control:
No time or thermostatic control of room temperature
Control code: 2101

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:
From main heating system
Water code: 901
Fuel :mains gas

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SAP Input

	Hot water cylinder Cylinder volume: 250 litres Cylinder insulation: Factory 15 mm Primary pipework insulation: False Cylinderstat: False Cylinder in heated space: False Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	91.6	(1a)	x	3.28	(2a)	=	300.45	(3a)
First floor	84.96	(1b)	x	2.65	(2b)	=	225.14	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	176.56	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	525.59	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	60	÷ (5) =	0.11	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.86	(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) =	0.73	(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

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SAP WorkSheet: New dwelling design stage

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

0.94	0.92	0.9	0.81	0.79	0.7	0.7	0.68	0.73	0.79	0.83	0.86

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=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(24d)

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

(25)m=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x	2	=	4.2			(26)
Doors Type 2			2.06	x	2	=	4.12			(26)
Windows Type 1			1.93	x1/[1/(4.5)+ 0.04]		=	7.36			(27)
Windows Type 2			1.8	x1/[1/(4.5)+ 0.04]		=	6.86			(27)
Windows Type 3			1.8	x1/[1/(4.5)+ 0.04]		=	6.86			(27)
Windows Type 4			1.84	x1/[1/(4.5)+ 0.04]		=	7.02			(27)
Windows Type 5			1.43	x1/[1/(4.5)+ 0.04]		=	5.45			(27)
Windows Type 6			1.43	x1/[1/(4.5)+ 0.04]		=	5.45			(27)
Windows Type 7			1.43	x1/[1/(4.5)+ 0.04]		=	5.45			(27)
Rooflights			1.2	x1/[1/(4.5) + 0.04]		=	5.4			(27b)
Floor			68.67	x	0.25	=	17.1675			(28)
Walls Type1	110.67	33.64	77.03	x	0.45	=	34.66			(29)
Walls Type2	21.14	0	21.14	x	0.2	=	4.31			(29)
Walls Type3	48.08	0	48.08	x	0.45	=	21.63			(29)
Roof Type1	39.87	0	39.87	x	0.2	=	7.97			(30)
Roof Type2	84.96	1.2	83.76	x	0.2	=	16.75			(30)
Total area of elements, m²			375.48							(31)

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SAP WorkSheet: New dwelling design stage

Party wall	71.63	x	0	=	0			(32)
Party wall	118.11	x	0	=	0			(32)

** 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) =	235.83	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		56.32	(36)

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

Total fabric heat loss	(33) + (36) =	292.15	(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=	162.79	159.83	156.94	143.34	140.79	128.95	128.95	126.76	133.51	140.79	145.94	151.32	(38)

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

(39)m=	454.94	451.99	449.09	435.49	432.95	421.11	421.11	418.91	425.67	432.95	438.1	443.48

Average = Sum(39)$_{1…12}$ /12= 435.48 (39)

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

(40)m=	2.58	2.56	2.54	2.47	2.45	2.39	2.39	2.37	2.41	2.45	2.48	2.51

Average = Sum(40)$_{1…12}$ /12= 2.47 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.97 (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) + 36 104.77 (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=	115.24	111.05	106.86	102.67	98.48	94.29	94.29	98.48	102.67	106.86	111.05	115.24

Total = Sum(44)$_{1…12}$ = 1257.22 (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=	170.9	149.47	154.24	134.47	129.03	111.34	103.18	118.4	119.81	139.63	152.41	165.51

Total = Sum(45)$_{1…12}$ = 1648.41 (45)

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

(46)m=	25.64	22.42	23.14	20.17	19.35	16.7	15.48	17.76	17.97	20.94	22.86	24.83	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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:

SAP WorkSheet: New dwelling design stage

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.03	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.78	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	5.18	(54)
Enter (50) or (54) in (55)		5.18	(55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	459.96	410.55	443.3	414.2	418.08	308.75	307.17	322.39	317.22	428.68	432.14	454.56	(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=	459.96	410.55	443.3	414.2	418.08	308.75	307.17	322.39	317.22	428.68	432.14	454.56

Output from water heater (annual)$_{1...12}$ — 4717 (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=	159.53	142.46	153.99	144.1	145.6	70.55	68.96	74.02	73.37	149.13	150.07	157.73	(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=	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	(66)

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

(67)m=	77.6	68.93	56.05	42.44	31.72	26.78	28.94	37.61	50.49	64.1	74.82	79.76	(67)

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

(68)m=	519.67	525.07	511.48	482.55	446.03	411.71	388.78	383.39	396.97	425.9	462.42	496.75	(68)

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

(69)m=	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	(71)

Water heating gains (Table 5)

(72)m=	214.42	212	206.97	200.14	195.7	97.99	92.68	99.49	101.9	200.44	208.43	212.01	(72)

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

(73)m=	926.92	921.22	889.73	840.35	788.68	651.71	625.62	635.71	664.59	805.67	860.89	903.74	(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	1	x	1.84	x	10.63	x	0.65	x	0.7	=	16.02	(74)
North	0.9x	1	x	1.43	x	10.63	x	0.65	x	0.7	=	18.68	(74)
North	0.9x	1	x	1.84	x	20.32	x	0.65	x	0.7	=	30.62	(74)
North	0.9x	1	x	1.43	x	20.32	x	0.65	x	0.7	=	35.7	(74)
North	0.9x	1	x	1.84	x	34.53	x	0.65	x	0.7	=	52.04	(74)
North	0.9x	1	x	1.43	x	34.53	x	0.65	x	0.7	=	60.66	(74)
North	0.9x	1	x	1.84	x	55.46	x	0.65	x	0.7	=	83.58	(74)
North	0.9x	1	x	1.43	x	55.46	x	0.65	x	0.7	=	97.44	(74)
North	0.9x	1	x	1.84	x	74.72	x	0.65	x	0.7	=	112.59	(74)
North	0.9x	1	x	1.43	x	74.72	x	0.65	x	0.7	=	131.26	(74)
North	0.9x	1	x	1.84	x	79.99	x	0.65	x	0.7	=	120.53	(74)
North	0.9x	1	x	1.43	x	79.99	x	0.65	x	0.7	=	140.51	(74)
North	0.9x	1	x	1.84	x	74.68	x	0.65	x	0.7	=	112.53	(74)
North	0.9x	1	x	1.43	x	74.68	x	0.65	x	0.7	=	131.19	(74)
North	0.9x	1	x	1.84	x	59.25	x	0.65	x	0.7	=	89.28	(74)
North	0.9x	1	x	1.43	x	59.25	x	0.65	x	0.7	=	104.08	(74)
North	0.9x	1	x	1.84	x	41.52	x	0.65	x	0.7	=	62.56	(74)
North	0.9x	1	x	1.43	x	41.52	x	0.65	x	0.7	=	72.93	(74)
North	0.9x	1	x	1.84	x	24.19	x	0.65	x	0.7	=	36.45	(74)
North	0.9x	1	x	1.43	x	24.19	x	0.65	x	0.7	=	42.49	(74)
North	0.9x	1	x	1.84	x	13.12	x	0.65	x	0.7	=	19.77	(74)
North	0.9x	1	x	1.43	x	13.12	x	0.65	x	0.7	=	23.04	(74)
North	0.9x	1	x	1.84	x	8.86	x	0.65	x	0.7	=	13.36	(74)
North	0.9x	1	x	1.43	x	8.86	x	0.65	x	0.7	=	15.57	(74)
East	0.9x	3	x	1.8	x	19.64	x	0.65	x	0.7	=	43.43	(76)
East	0.9x	2	x	1.43	x	19.64	x	0.65	x	0.7	=	23	(76)
East	0.9x	3	x	1.8	x	38.42	x	0.65	x	0.7	=	84.96	(76)
East	0.9x	2	x	1.43	x	38.42	x	0.65	x	0.7	=	45	(76)
East	0.9x	3	x	1.8	x	63.27	x	0.65	x	0.7	=	139.92	(76)
East	0.9x	2	x	1.43	x	63.27	x	0.65	x	0.7	=	74.1	(76)

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SAP WorkSheet: New dwelling design stage

East	0.9x	3	x	1.8	x	92.28	x	0.65	x	0.7	=	204.06	(76)
East	0.9x	2	x	1.43	x	92.28	x	0.65	x	0.7	=	108.08	(76)
East	0.9x	3	x	1.8	x	113.09	x	0.65	x	0.7	=	250.08	(76)
East	0.9x	2	x	1.43	x	113.09	x	0.65	x	0.7	=	132.45	(76)
East	0.9x	3	x	1.8	x	115.77	x	0.65	x	0.7	=	256	(76)
East	0.9x	2	x	1.43	x	115.77	x	0.65	x	0.7	=	135.59	(76)
East	0.9x	3	x	1.8	x	110.22	x	0.65	x	0.7	=	243.73	(76)
East	0.9x	2	x	1.43	x	110.22	x	0.65	x	0.7	=	129.08	(76)
East	0.9x	3	x	1.8	x	94.68	x	0.65	x	0.7	=	209.36	(76)
East	0.9x	2	x	1.43	x	94.68	x	0.65	x	0.7	=	110.88	(76)
East	0.9x	3	x	1.8	x	73.59	x	0.65	x	0.7	=	162.73	(76)
East	0.9x	2	x	1.43	x	73.59	x	0.65	x	0.7	=	86.19	(76)
East	0.9x	3	x	1.8	x	45.59	x	0.65	x	0.7	=	100.81	(76)
East	0.9x	2	x	1.43	x	45.59	x	0.65	x	0.7	=	53.39	(76)
East	0.9x	3	x	1.8	x	24.49	x	0.65	x	0.7	=	54.15	(76)
East	0.9x	2	x	1.43	x	24.49	x	0.65	x	0.7	=	28.68	(76)
East	0.9x	3	x	1.8	x	16.15	x	0.65	x	0.7	=	35.72	(76)
East	0.9x	2	x	1.43	x	16.15	x	0.65	x	0.7	=	18.92	(76)
South	0.9x	1	x	1.93	x	46.75	x	0.65	x	0.7	=	73.9	(78)
South	0.9x	1	x	1.8	x	46.75	x	0.65	x	0.7	=	137.84	(78)
South	0.9x	1	x	1.43	x	46.75	x	0.65	x	0.7	=	82.13	(78)
South	0.9x	1	x	1.93	x	76.57	x	0.65	x	0.7	=	121.03	(78)
South	0.9x	1	x	1.8	x	76.57	x	0.65	x	0.7	=	225.75	(78)
South	0.9x	1	x	1.43	x	76.57	x	0.65	x	0.7	=	134.51	(78)
South	0.9x	1	x	1.93	x	97.53	x	0.65	x	0.7	=	154.17	(78)
South	0.9x	1	x	1.8	x	97.53	x	0.65	x	0.7	=	287.57	(78)
South	0.9x	1	x	1.43	x	97.53	x	0.65	x	0.7	=	171.34	(78)
South	0.9x	1	x	1.93	x	110.23	x	0.65	x	0.7	=	174.24	(78)
South	0.9x	1	x	1.8	x	110.23	x	0.65	x	0.7	=	325.02	(78)
South	0.9x	1	x	1.43	x	110.23	x	0.65	x	0.7	=	193.65	(78)
South	0.9x	1	x	1.93	x	114.87	x	0.65	x	0.7	=	181.57	(78)
South	0.9x	1	x	1.8	x	114.87	x	0.65	x	0.7	=	338.69	(78)
South	0.9x	1	x	1.43	x	114.87	x	0.65	x	0.7	=	201.8	(78)
South	0.9x	1	x	1.93	x	110.55	x	0.65	x	0.7	=	174.74	(78)
South	0.9x	1	x	1.8	x	110.55	x	0.65	x	0.7	=	325.94	(78)
South	0.9x	1	x	1.43	x	110.55	x	0.65	x	0.7	=	194.21	(78)
South	0.9x	1	x	1.93	x	108.01	x	0.65	x	0.7	=	170.73	(78)
South	0.9x	1	x	1.8	x	108.01	x	0.65	x	0.7	=	318.46	(78)
South	0.9x	1	x	1.43	x	108.01	x	0.65	x	0.7	=	189.75	(78)
South	0.9x	1	x	1.93	x	104.89	x	0.65	x	0.7	=	165.8	(78)
South	0.9x	1	x	1.8	x	104.89	x	0.65	x	0.7	=	309.27	(78)

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South	0.9x	1	x	1.43	x	104.89	x	0.65	x	0.7	=	184.27	(78)
South	0.9x	1	x	1.93	x	101.89	x	0.65	x	0.7	=	161.05	(78)
South	0.9x	1	x	1.8	x	101.89	x	0.65	x	0.7	=	300.4	(78)
South	0.9x	1	x	1.43	x	101.89	x	0.65	x	0.7	=	178.99	(78)
South	0.9x	1	x	1.93	x	82.59	x	0.65	x	0.7	=	130.54	(78)
South	0.9x	1	x	1.8	x	82.59	x	0.65	x	0.7	=	243.5	(78)
South	0.9x	1	x	1.43	x	82.59	x	0.65	x	0.7	=	145.08	(78)
South	0.9x	1	x	1.93	x	55.42	x	0.65	x	0.7	=	87.6	(78)
South	0.9x	1	x	1.8	x	55.42	x	0.65	x	0.7	=	163.39	(78)
South	0.9x	1	x	1.43	x	55.42	x	0.65	x	0.7	=	97.35	(78)
South	0.9x	1	x	1.93	x	40.4	x	0.65	x	0.7	=	63.86	(78)
South	0.9x	1	x	1.8	x	40.4	x	0.65	x	0.7	=	119.11	(78)
South	0.9x	1	x	1.43	x	40.4	x	0.65	x	0.7	=	70.97	(78)
Rooflights	0.9x	1	x	1.2	x	26	x	0.65	x	0.7	=	12.78	(82)
Rooflights	0.9x	1	x	1.2	x	54	x	0.65	x	0.7	=	26.54	(82)
Rooflights	0.9x	1	x	1.2	x	96	x	0.65	x	0.7	=	47.17	(82)
Rooflights	0.9x	1	x	1.2	x	150	x	0.65	x	0.7	=	73.71	(82)
Rooflights	0.9x	1	x	1.2	x	192	x	0.65	x	0.7	=	94.35	(82)
Rooflights	0.9x	1	x	1.2	x	200	x	0.65	x	0.7	=	98.28	(82)
Rooflights	0.9x	1	x	1.2	x	189	x	0.65	x	0.7	=	92.87	(82)
Rooflights	0.9x	1	x	1.2	x	157	x	0.65	x	0.7	=	77.15	(82)
Rooflights	0.9x	1	x	1.2	x	115	x	0.65	x	0.7	=	56.51	(82)
Rooflights	0.9x	1	x	1.2	x	66	x	0.65	x	0.7	=	32.43	(82)
Rooflights	0.9x	1	x	1.2	x	33	x	0.65	x	0.7	=	16.22	(82)
Rooflights	0.9x	1	x	1.2	x	21	x	0.65	x	0.7	=	10.32	(82)

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

(83)m=	407.79	704.11	986.97	1259.78	1442.79	1445.8	1388.35	1250.1	1081.36	784.7	490.2	347.82	(83)

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

(84)m=	1334.71	1625.32	1876.7	2100.13	2231.47	2097.51	2013.98	1885.81	1745.95	1590.38	1351.1	1251.55	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.91	0.83	0.71	0.75	0.9	0.97	0.99	0.99	(86)

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

(87)m=	18.35	18.6	19.02	19.6	20.14	20.59	20.82	20.78	20.41	19.73	18.97	18.36	(87)

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

(88)m=	19.71	19.72	19.73	19.77	19.77	19.81	19.81	19.81	19.79	19.77	19.76	19.74	(88)

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

(89)m=	0.99	0.99	0.97	0.94	0.88	0.76	0.58	0.64	0.85	0.96	0.99	0.99	(89)

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

SAP WorkSheet: New dwelling design stage

(90)m=	17.31	17.56	17.98	18.59	19.12	19.55	19.73	19.71	19.39	18.72	17.96	17.34	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	17.63	17.88	18.3	18.9	19.43	19.87	20.07	20.04	19.7	19.03	18.27	17.65	(92)

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

(93)m=	18.23	18.48	18.9	19.5	20.03	20.47	20.67	20.64	20.3	19.63	18.87	18.25	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.94	0.89	0.8	0.68	0.72	0.87	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1321.16	1596.53	1817.86	1975.43	1979.9	1685.95	1375.35	1365.72	1525.58	1517.91	1329.48	1241.1	(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=	6337.21	6138.39	5568.53	4615.16	3606.45	2470.86	1712.07	1776.53	2639.72	3908.74	5154.28	6230.15	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3731.94	3052.13	2790.5	1900.6	1210.16	0	0	0	0	1778.78	2753.86	3711.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 20929.82 (98)

Space heating requirement in kWh/m²/year 118.54 (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		61	(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)													
	3731.94	3052.13	2790.5	1900.6	1210.16	0	0	0	0	1778.78	2753.86	3711.85	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	6117.93	5003.5	4574.59	3115.74	1983.86	0	0	0	0	2916.03	4514.52	6084.99	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 34311.17 (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)

459.96	410.55	443.3	414.2	418.08	308.75	307.17	322.39	317.22	428.68	432.14	454.56

Efficiency of water heater 51 (216)

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SAP WorkSheet: New dwelling design stage

(217)m=	59.72	59.61	59.4	58.93	58.08	51	51	51	51	58.76	59.42	59.72	(217)

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

(219)m=	770.25	688.69	746.25	702.84	719.89	605.4	602.28	632.13	622	729.51	727.27	761.13

Total = Sum(219a)$_{1...12}$ = 8307.64 (219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			34311.17	
Water heating fuel used			8307.64	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)
Electricity for lighting			548.19	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	1194.03	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	289.11	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	26.51	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a						
Energy for lighting	(232)		13.19	x 0.01 =	72.31	(250)
Additional standing charges (Table 12)					120	(251)

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

Total energy cost (245)...(247) + (250)…(254) = 1701.95 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	3.23	(257)
SAP rating (Section 12)		54.99	(258)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	7411.21	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1794.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =				9205.66	(265)

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Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	104.32	(267)
Electricity for lighting	(232) x	0.519	=	284.51	(268)
Total CO2, kg/year		sum of (265)…(271) =		9594.49	(272)
CO2 emissions per m²		(272) ÷ (4) =		54.34	(273)
EI rating (section 14)				45	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	41859.63	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	10135.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			51994.96	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	617.07	(267)
Electricity for lighting	(232) x	0	=	1682.94	(268)
'Total Primary Energy		sum of (265)…(271) =		54294.96	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		307.52	(273)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	91.6	(1a)	x	3.28	(2a)	=	300.45	(3a)
First floor	84.96	(1b)	x	2.65	(2b)	=	225.14	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	176.56	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	525.59	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	60	÷ (5) =	0.11	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.86	(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) =	0.73	(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

0.94	0.92	0.9	0.81	0.79	0.7	0.7	0.68	0.73	0.79	0.83	0.86

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=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(24d)

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

(25)m=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x	2	=	4.2			(26)
Doors Type 2			2.06	x	2	=	4.12			(26)
Windows Type 1			1.93	x1/[1/(4.5)+ 0.04]		=	7.36			(27)
Windows Type 2			1.8	x1/[1/(4.5)+ 0.04]		=	6.86			(27)
Windows Type 3			1.8	x1/[1/(4.5)+ 0.04]		=	6.86			(27)
Windows Type 4			1.84	x1/[1/(4.5)+ 0.04]		=	7.02			(27)
Windows Type 5			1.43	x1/[1/(4.5)+ 0.04]		=	5.45			(27)
Windows Type 6			1.43	x1/[1/(4.5)+ 0.04]		=	5.45			(27)
Windows Type 7			1.43	x1/[1/(4.5)+ 0.04]		=	5.45			(27)
Rooflights			1.2	x1/[1/(4.5) + 0.04]		=	5.4			(27b)
Floor			68.67	x	0.25	=	17.1675			(28)
Walls Type1	110.67	33.64	77.03	x	0.45	=	34.66			(29)
Walls Type2	21.14	0	21.14	x	0.2	=	4.31			(29)
Walls Type3	48.08	0	48.08	x	0.45	=	21.63			(29)
Roof Type1	39.87	0	39.87	x	0.2	=	7.97			(30)
Roof Type2	84.96	1.2	83.76	x	0.2	=	16.75			(30)
Total area of elements, m²			375.48							(31)

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DER WorkSheet: New dwelling design stage

Party wall	71.63	x	0	=	0			(32)
Party wall	118.11	x	0	=	0			(32)

** 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) =	235.83	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		56.32	(36)

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

Total fabric heat loss	(33) + (36) =	292.15	(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=	162.79	159.83	156.94	143.34	140.79	128.95	128.95	126.76	133.51	140.79	145.94	151.32	(38)

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

(39)m=	454.94	451.99	449.09	435.49	432.95	421.11	421.11	418.91	425.67	432.95	438.1	443.48	

Average = Sum(39)$_{1…12}$ /12= 435.48 (39)

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

(40)m=	2.58	2.56	2.54	2.47	2.45	2.39	2.39	2.37	2.41	2.45	2.48	2.51	

Average = Sum(40)$_{1…12}$ /12= 2.47 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.97 (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) + 36 104.77 (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=	115.24	111.05	106.86	102.67	98.48	94.29	94.29	98.48	102.67	106.86	111.05	115.24	

Total = Sum(44)$_{1…12}$ = 1257.22 (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=	170.9	149.47	154.24	134.47	129.03	111.34	103.18	118.4	119.81	139.63	152.41	165.51	

Total = Sum(45)$_{1…12}$ = 1648.41 (45)

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

(46)m=	25.64	22.42	23.14	20.17	19.35	16.7	15.48	17.76	17.97	20.94	22.86	24.83	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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:

DER WorkSheet: New dwelling design stage

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.03	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.78	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	5.18	(54)
Enter (50) or (54) in (55)		5.18	(55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(59)

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

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

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

(62)m=	459.96	410.55	443.3	414.2	418.08	308.75	307.17	322.39	317.22	428.68	432.14	454.56	(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=	459.96	410.55	443.3	414.2	418.08	308.75	307.17	322.39	317.22	428.68	432.14	454.56	

Output from water heater (annual)$_{1...12}$ | 4717 | (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=	159.53	142.46	153.99	144.1	145.6	70.55	68.96	74.02	73.37	149.13	150.07	157.73	(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=	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	(66)

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

(67)m=	31.04	27.57	22.42	16.97	12.69	10.71	11.57	15.04	20.19	25.64	29.93	31.9	(67)

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

(68)m=	348.18	351.8	342.69	323.31	298.84	275.84	260.48	256.87	265.97	285.36	309.82	332.82	(68)

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

(69)m=	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	(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=	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	(71)

Water heating gains (Table 5)

(72)m=	214.42	212	206.97	200.14	195.7	97.99	92.68	99.49	101.9	200.44	208.43	212.01	(72)

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

(73)m=	661.21	658.93	639.65	607.99	574.8	452.12	432.31	438.97	455.64	579.01	615.74	644.3	(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	1.84	x	10.63	x	0.65	x	0.7	=	12.34	(74)
North	0.9x	0.77	x	1.43	x	10.63	x	0.65	x	0.7	=	14.38	(74)
North	0.9x	0.77	x	1.84	x	20.32	x	0.65	x	0.7	=	23.58	(74)
North	0.9x	0.77	x	1.43	x	20.32	x	0.65	x	0.7	=	27.49	(74)
North	0.9x	0.77	x	1.84	x	34.53	x	0.65	x	0.7	=	40.07	(74)
North	0.9x	0.77	x	1.43	x	34.53	x	0.65	x	0.7	=	46.71	(74)
North	0.9x	0.77	x	1.84	x	55.46	x	0.65	x	0.7	=	64.36	(74)
North	0.9x	0.77	x	1.43	x	55.46	x	0.65	x	0.7	=	75.03	(74)
North	0.9x	0.77	x	1.84	x	74.72	x	0.65	x	0.7	=	86.7	(74)
North	0.9x	0.77	x	1.43	x	74.72	x	0.65	x	0.7	=	101.07	(74)
North	0.9x	0.77	x	1.84	x	79.99	x	0.65	x	0.7	=	92.81	(74)
North	0.9x	0.77	x	1.43	x	79.99	x	0.65	x	0.7	=	108.2	(74)
North	0.9x	0.77	x	1.84	x	74.68	x	0.65	x	0.7	=	86.65	(74)
North	0.9x	0.77	x	1.43	x	74.68	x	0.65	x	0.7	=	101.02	(74)
North	0.9x	0.77	x	1.84	x	59.25	x	0.65	x	0.7	=	68.75	(74)
North	0.9x	0.77	x	1.43	x	59.25	x	0.65	x	0.7	=	80.14	(74)
North	0.9x	0.77	x	1.84	x	41.52	x	0.65	x	0.7	=	48.17	(74)
North	0.9x	0.77	x	1.43	x	41.52	x	0.65	x	0.7	=	56.16	(74)
North	0.9x	0.77	x	1.84	x	24.19	x	0.65	x	0.7	=	28.07	(74)
North	0.9x	0.77	x	1.43	x	24.19	x	0.65	x	0.7	=	32.72	(74)
North	0.9x	0.77	x	1.84	x	13.12	x	0.65	x	0.7	=	15.22	(74)
North	0.9x	0.77	x	1.43	x	13.12	x	0.65	x	0.7	=	17.74	(74)
North	0.9x	0.77	x	1.84	x	8.86	x	0.65	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.43	x	8.86	x	0.65	x	0.7	=	11.99	(74)
East	0.9x	3	x	1.8	x	19.64	x	0.65	x	0.7	=	33.44	(76)
East	0.9x	2	x	1.43	x	19.64	x	0.65	x	0.7	=	17.71	(76)
East	0.9x	3	x	1.8	x	38.42	x	0.65	x	0.7	=	65.42	(76)
East	0.9x	2	x	1.43	x	38.42	x	0.65	x	0.7	=	34.65	(76)
East	0.9x	3	x	1.8	x	63.27	x	0.65	x	0.7	=	107.74	(76)
East	0.9x	2	x	1.43	x	63.27	x	0.65	x	0.7	=	57.06	(76)

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DER WorkSheet: New dwelling design stage

East	0.9x	3	x	1.8	x	92.28	x	0.65	x	0.7	=	157.13	(76)
East	0.9x	2	x	1.43	x	92.28	x	0.65	x	0.7	=	83.22	(76)
East	0.9x	3	x	1.8	x	113.09	x	0.65	x	0.7	=	192.56	(76)
East	0.9x	2	x	1.43	x	113.09	x	0.65	x	0.7	=	101.99	(76)
East	0.9x	3	x	1.8	x	115.77	x	0.65	x	0.7	=	197.12	(76)
East	0.9x	2	x	1.43	x	115.77	x	0.65	x	0.7	=	104.4	(76)
East	0.9x	3	x	1.8	x	110.22	x	0.65	x	0.7	=	187.67	(76)
East	0.9x	2	x	1.43	x	110.22	x	0.65	x	0.7	=	99.39	(76)
East	0.9x	3	x	1.8	x	94.68	x	0.65	x	0.7	=	161.2	(76)
East	0.9x	2	x	1.43	x	94.68	x	0.65	x	0.7	=	85.38	(76)
East	0.9x	3	x	1.8	x	73.59	x	0.65	x	0.7	=	125.3	(76)
East	0.9x	2	x	1.43	x	73.59	x	0.65	x	0.7	=	66.36	(76)
East	0.9x	3	x	1.8	x	45.59	x	0.65	x	0.7	=	77.62	(76)
East	0.9x	2	x	1.43	x	45.59	x	0.65	x	0.7	=	41.11	(76)
East	0.9x	3	x	1.8	x	24.49	x	0.65	x	0.7	=	41.7	(76)
East	0.9x	2	x	1.43	x	24.49	x	0.65	x	0.7	=	22.08	(76)
East	0.9x	3	x	1.8	x	16.15	x	0.65	x	0.7	=	27.5	(76)
East	0.9x	2	x	1.43	x	16.15	x	0.65	x	0.7	=	14.57	(76)
South	0.9x	0.77	x	1.93	x	46.75	x	0.65	x	0.7	=	56.9	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.65	x	0.7	=	106.14	(78)
South	0.9x	0.77	x	1.43	x	46.75	x	0.65	x	0.7	=	63.24	(78)
South	0.9x	0.77	x	1.93	x	76.57	x	0.65	x	0.7	=	93.19	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.65	x	0.7	=	173.83	(78)
South	0.9x	0.77	x	1.43	x	76.57	x	0.65	x	0.7	=	103.57	(78)
South	0.9x	0.77	x	1.93	x	97.53	x	0.65	x	0.7	=	118.71	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.65	x	0.7	=	221.43	(78)
South	0.9x	0.77	x	1.43	x	97.53	x	0.65	x	0.7	=	131.93	(78)
South	0.9x	0.77	x	1.93	x	110.23	x	0.65	x	0.7	=	134.17	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.65	x	0.7	=	250.26	(78)
South	0.9x	0.77	x	1.43	x	110.23	x	0.65	x	0.7	=	149.11	(78)
South	0.9x	0.77	x	1.93	x	114.87	x	0.65	x	0.7	=	139.81	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.65	x	0.7	=	260.79	(78)
South	0.9x	0.77	x	1.43	x	114.87	x	0.65	x	0.7	=	155.39	(78)
South	0.9x	0.77	x	1.93	x	110.55	x	0.65	x	0.7	=	134.55	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.65	x	0.7	=	250.97	(78)
South	0.9x	0.77	x	1.43	x	110.55	x	0.65	x	0.7	=	149.54	(78)
South	0.9x	0.77	x	1.93	x	108.01	x	0.65	x	0.7	=	131.46	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.65	x	0.7	=	245.22	(78)
South	0.9x	0.77	x	1.43	x	108.01	x	0.65	x	0.7	=	146.11	(78)
South	0.9x	0.77	x	1.93	x	104.89	x	0.65	x	0.7	=	127.67	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.65	x	0.7	=	238.14	(78)

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South	0.9x	0.77	x	1.43	x	104.89	x	0.65	x	0.7	=	141.89	(78)
South	0.9x	0.77	x	1.93	x	101.89	x	0.65	x	0.7	=	124.01	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.65	x	0.7	=	231.31	(78)
South	0.9x	0.77	x	1.43	x	101.89	x	0.65	x	0.7	=	137.82	(78)
South	0.9x	0.77	x	1.93	x	82.59	x	0.65	x	0.7	=	100.52	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.65	x	0.7	=	187.49	(78)
South	0.9x	0.77	x	1.43	x	82.59	x	0.65	x	0.7	=	111.71	(78)
South	0.9x	0.77	x	1.93	x	55.42	x	0.65	x	0.7	=	67.45	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.65	x	0.7	=	125.81	(78)
South	0.9x	0.77	x	1.43	x	55.42	x	0.65	x	0.7	=	74.96	(78)
South	0.9x	0.77	x	1.93	x	40.4	x	0.65	x	0.7	=	49.17	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.65	x	0.7	=	91.71	(78)
South	0.9x	0.77	x	1.43	x	40.4	x	0.65	x	0.7	=	54.65	(78)
Rooflights	0.9x	1	x	1.2	x	26	x	0.65	x	0.7	=	12.78	(82)
Rooflights	0.9x	1	x	1.2	x	54	x	0.65	x	0.7	=	26.54	(82)
Rooflights	0.9x	1	x	1.2	x	96	x	0.65	x	0.7	=	47.17	(82)
Rooflights	0.9x	1	x	1.2	x	150	x	0.65	x	0.7	=	73.71	(82)
Rooflights	0.9x	1	x	1.2	x	192	x	0.65	x	0.7	=	94.35	(82)
Rooflights	0.9x	1	x	1.2	x	200	x	0.65	x	0.7	=	98.28	(82)
Rooflights	0.9x	1	x	1.2	x	189	x	0.65	x	0.7	=	92.87	(82)
Rooflights	0.9x	1	x	1.2	x	157	x	0.65	x	0.7	=	77.15	(82)
Rooflights	0.9x	1	x	1.2	x	115	x	0.65	x	0.7	=	56.51	(82)
Rooflights	0.9x	1	x	1.2	x	66	x	0.65	x	0.7	=	32.43	(82)
Rooflights	0.9x	1	x	1.2	x	33	x	0.65	x	0.7	=	16.22	(82)
Rooflights	0.9x	1	x	1.2	x	21	x	0.65	x	0.7	=	10.32	(82)

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

(83)m=	316.94	548.26	770.82	986.98	1132.65	1135.87	1090.39	980.32	845.64	611.68	381.19	270.19	(83)

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

(84)m=	978.15	1207.2	1410.47	1594.97	1707.45	1587.99	1522.7	1419.29	1301.28	1190.69	996.93	914.49	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.98	0.95	0.9	0.81	0.85	0.95	0.98	1	1	(86)

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

(87)m=	18.2	18.43	18.83	19.41	19.97	20.45	20.73	20.69	20.26	19.57	18.82	18.21	(87)

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

(88)m=	19.71	19.72	19.73	19.77	19.77	19.81	19.81	19.81	19.79	19.77	19.76	19.74	(88)

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

(89)m=	1	0.99	0.99	0.97	0.93	0.85	0.7	0.75	0.92	0.98	0.99	1	(89)

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

DER WorkSheet: New dwelling design stage

(90)m=	17.16	17.39	17.8	18.4	18.95	19.44	19.68	19.65	19.26	18.57	17.81	17.19	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	17.48	17.71	18.11	18.71	19.26	19.75	20.01	19.97	19.57	18.87	18.12	17.51	(92)

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

(93)m=	18.08	18.31	18.71	19.31	19.86	20.35	20.61	20.57	20.17	19.47	18.72	18.11	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.97	0.93	0.88	0.78	0.82	0.93	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	973.57	1196.77	1387.6	1542.86	1592.75	1393.06	1192.41	1161.74	1207.74	1162.5	989.42	911.06	(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=	6270	6061.13	5485.38	4533.17	3534.85	2422.02	1686.77	1747	2583.29	3841.88	5089.96	6167.41	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3940.54	3268.85	3048.75	2153.02	1444.93	0	0	0	0	1993.46	2952.38	3910.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 22712.66 (98)

Space heating requirement in kWh/m²/year 128.64 (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		61	(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)													
	3940.54	3268.85	3048.75	2153.02	1444.93	0	0	0	0	1993.46	2952.38	3910.72	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	6459.91	5358.77	4997.95	3529.54	2368.73	0	0	0	0	3267.97	4839.98	6411.02	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 37233.87 (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)

459.96	410.55	443.3	414.2	418.08	308.75	307.17	322.39	317.22	428.68	432.14	454.56

Efficiency of water heater 51 (216)

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(217)m=	59.77	59.69	59.52	59.13	58.43	51	51	51	51	58.95	59.51	59.78	(217)

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

(219)m=	769.48	687.76	744.8	700.5	715.54	605.4	602.28	632.13	622	727.14	726.17	760.4

Total = Sum(219a)$_{1...12}$ = 8293.61 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			37233.87	
Water heating fuel used			8293.61	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)
Electricity for lighting			548.16	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	8042.52	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1791.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =				9833.94	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	104.32	(267)
Electricity for lighting	(232)	x	0.519	=	284.5	(268)
Total CO2, kg/year			sum of (265)…(271) =		10222.75	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		57.9	(273)
EI rating (section 14)					42	(274)

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SAP Input

Property Details: Flat 3

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2015	
Floor Location:	Floor area:	Storey height:
Floor 0	40.62 m²	3.2 m
Floor 1	110.03 m²	2.65 m
Living area:	69.89 m² (fraction 0.464)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
W1	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	Wood
W2	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
W3	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
W4	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
w5	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U
RFl2	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
W1	16mm or more	0.7	0.65	4.5	1.86	3
W2	16mm or more	0.7	0.65	4.5	0.75	4
W3	16mm or more	0.7	0.65	4.5	1.2	2
W4	16mm or more	0.7	0.85	4.5	1.2	2
w5	16mm or more	0.7	0.85	4.5	8.4	1
RF1	16mm or more	0.7	0.65	4.5	2.49	1
RFl2	16mm or more	0.7	0.65	4.5	3.35	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
W1		External wall GF	South	1.161	1.6
W2		External FF	South	1	0.75
W3		External FF	West	1	1.2
W4		External FF	North	1	1.2
w5		External FF	East	4	2.1
RF1		Flat roof 2	Horizontal	1.868	1.331
RFl2		Flat roof 2	Horizontal	1.83	1.83

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SAP Input

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External wall GF	26.056	5.58	20.48	0.45	0	False	N/A
corridor GF	21.14	0	21.14	0.25	0.9	False	N/A
External FF	80.03	16.2	63.83	0.45	0	False	N/A
flat roof 1	110.03	0	110.03	0.2	0		N/A
Internal Elements							
Party Elements							
party GF	48.104						N/A
Party wall FF	22.83						N/A

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	No (Assumed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	1 (main: 0, secondary: 0, other: 1)
Number of open flues:	0
Number of fans:	4
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	15

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Main heating system:

Main heating system:
Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: SAP Tables
SAP Table: 115
Wall mounted
Systems with radiators
Design flow temperature: Unknown
Open
Boiler interlock: Yes

Main heating Control:

Main heating Control:
No time or thermostatic control of room temperature
Control code: 2101

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:
From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 250 litres
Cylinder insulation: Factory 15 mm
Primary pipework insulation: False
Cylinderstat: False
Cylinder in heated space: False
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes

SAP Input

Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	40.62	(1a) x	3.2	(2a) =	129.98	(3a)
First floor	110.03	(1b) x	2.65	(2b) =	291.58	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150.65	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		421.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.19	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.94	(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) =	0.8	(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

SAP WorkSheet: New dwelling design stage

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

1.02	1	0.98	0.88	0.86	0.76	0.76	0.74	0.8	0.86	0.9	0.94

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=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(24d)

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

(25)m=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(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	2	=	4.2			(26)
Windows Type 1			1.86	x1/[1/(4.5)+ 0.04]		=	7.09			(27)
Windows Type 2			0.75	x1/[1/(4.5)+ 0.04]		=	2.86			(27)
Windows Type 3			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 4			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 5			8.4	x1/[1/(4.5)+ 0.04]		=	32.03			(27)
Rooflights Type 1			2.49	x1/[1/(4.5) + 0.04]		=	11.205			(27b)
Rooflights Type 2			3.35	x1/[1/(4.5) + 0.04]		=	15.075			(27b)
Walls Type1	26.06	5.58	20.48	x	0.45	=	9.21			(29)
Walls Type2	21.14	0	21.14	x	0.2	=	4.31			(29)
Walls Type3	80.03	16.2	63.83	x	0.45	=	28.72			(29)
Roof	110.03	0	110.03	x	0.2	=	22.01			(30)
Total area of elements, m²			245.2							(31)
Party wall			48.1	x	0	=	0			(32)
Party wall			22.83	x	0	=	0			(32)

** 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) =	173.79	(33)

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SAP WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)		((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K		Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		36.78	(36)

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

Total fabric heat loss	(33) + (36) =	210.57	(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=	141.69	138.91	136.16	123.26	120.85	109.61	109.61	107.53	113.94	120.85	125.73	130.84	(38)

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

(39)m=	352.25	349.48	346.73	333.83	331.42	320.18	320.18	318.1	324.51	331.42	336.3	341.4	

Average = Sum(39)1…12 /12= 333.82 (39)

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

(40)m=	2.34	2.32	2.3	2.22	2.2	2.13	2.13	2.11	2.15	2.2	2.23	2.27	

Average = Sum(40)1…12 /12= 2.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.94 (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 — 103.91 (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=	114.3	110.15	105.99	101.83	97.68	93.52	93.52	97.68	101.83	105.99	110.15	114.3	

Total = Sum(44)1…12 = 1246.93 (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=	169.51	148.25	152.98	133.37	127.98	110.43	102.33	117.43	118.83	138.49	151.17	164.16	

Total = Sum(45)1…12 = 1634.92 (45)

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

(46)m=	25.43	22.24	22.95	20.01	19.2	16.56	15.35	17.61	17.82	20.77	22.68	24.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		250	(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) =	250	(50)

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

SAP WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)		0.03	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.78	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	5.18	(54)
Enter (50) or (54) in (55)		5.18	(55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	458.56	409.33	442.04	413.1	417.03	307.84	306.32	321.42	316.24	427.54	430.9	453.21	(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=	458.56	409.33	442.04	413.1	417.03	307.84	306.32	321.42	316.24	427.54	430.9	453.21	

Output from water heater (annual)$_{1...12}$ — 4703.52 (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=	159.06	142.06	153.57	143.74	145.25	70.25	68.68	73.7	73.04	148.75	149.65	157.28	(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=	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	(66)

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

(67)m=	71.61	63.6	51.73	39.16	29.27	24.71	26.7	34.71	46.59	59.15	69.04	73.6	(67)

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

(68)m=	479.45	484.42	471.88	445.19	411.5	379.84	358.68	353.71	366.24	392.93	426.63	458.29	(68)

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

(69)m=	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	(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=	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	(71)

Water heating gains (Table 5)

(72)m=	213.79	211.39	206.41	199.63	195.23	97.57	92.31	99.05	101.45	199.93	207.85	211.4	(72)

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SAP WorkSheet: New dwelling design stage

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

(73)m=	879.1	873.67	844.27	798.24	750.26	616.37	591.94	601.72	628.53	766.27	817.77	857.55	(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	1	x	1.2	x	10.63	x	0.85	x	0.7	=	13.67	(74)
North	0.9x	1	x	1.2	x	20.32	x	0.85	x	0.7	=	26.12	(74)
North	0.9x	1	x	1.2	x	34.53	x	0.85	x	0.7	=	44.38	(74)
North	0.9x	1	x	1.2	x	55.46	x	0.85	x	0.7	=	71.28	(74)
North	0.9x	1	x	1.2	x	74.72	x	0.85	x	0.7	=	96.02	(74)
North	0.9x	1	x	1.2	x	79.99	x	0.85	x	0.7	=	102.8	(74)
North	0.9x	1	x	1.2	x	74.68	x	0.85	x	0.7	=	95.97	(74)
North	0.9x	1	x	1.2	x	59.25	x	0.85	x	0.7	=	76.14	(74)
North	0.9x	1	x	1.2	x	41.52	x	0.85	x	0.7	=	53.36	(74)
North	0.9x	1	x	1.2	x	24.19	x	0.85	x	0.7	=	31.09	(74)
North	0.9x	1	x	1.2	x	13.12	x	0.85	x	0.7	=	16.86	(74)
North	0.9x	1	x	1.2	x	8.86	x	0.85	x	0.7	=	11.39	(74)
East	0.9x	1	x	8.4	x	19.64	x	0.85	x	0.7	=	88.35	(76)
East	0.9x	1	x	8.4	x	38.42	x	0.85	x	0.7	=	172.82	(76)
East	0.9x	1	x	8.4	x	63.27	x	0.85	x	0.7	=	284.62	(76)
East	0.9x	1	x	8.4	x	92.28	x	0.85	x	0.7	=	415.09	(76)
East	0.9x	1	x	8.4	x	113.09	x	0.85	x	0.7	=	508.71	(76)
East	0.9x	1	x	8.4	x	115.77	x	0.85	x	0.7	=	520.76	(76)
East	0.9x	1	x	8.4	x	110.22	x	0.85	x	0.7	=	495.78	(76)
East	0.9x	1	x	8.4	x	94.68	x	0.85	x	0.7	=	425.87	(76)
East	0.9x	1	x	8.4	x	73.59	x	0.85	x	0.7	=	331.02	(76)
East	0.9x	1	x	8.4	x	45.59	x	0.85	x	0.7	=	205.07	(76)
East	0.9x	1	x	8.4	x	24.49	x	0.85	x	0.7	=	110.16	(76)
East	0.9x	1	x	8.4	x	16.15	x	0.85	x	0.7	=	72.65	(76)
South	0.9x	1	x	1.86	x	46.75	x	0.65	x	0.7	=	106.83	(78)
South	0.9x	1	x	0.75	x	46.75	x	0.65	x	0.7	=	57.43	(78)
South	0.9x	1	x	1.86	x	76.57	x	0.65	x	0.7	=	174.96	(78)
South	0.9x	1	x	0.75	x	76.57	x	0.65	x	0.7	=	94.06	(78)
South	0.9x	1	x	1.86	x	97.53	x	0.65	x	0.7	=	222.87	(78)
South	0.9x	1	x	0.75	x	97.53	x	0.65	x	0.7	=	119.82	(78)
South	0.9x	1	x	1.86	x	110.23	x	0.65	x	0.7	=	251.89	(78)
South	0.9x	1	x	0.75	x	110.23	x	0.65	x	0.7	=	135.42	(78)
South	0.9x	1	x	1.86	x	114.87	x	0.65	x	0.7	=	262.48	(78)
South	0.9x	1	x	0.75	x	114.87	x	0.65	x	0.7	=	141.12	(78)

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SAP WorkSheet: New dwelling design stage

South	0.9x	1	x	1.86	x	110.55	x	0.65	x	0.7	=	252.6	(78)
South	0.9x	1	x	0.75	x	110.55	x	0.65	x	0.7	=	135.81	(78)
South	0.9x	1	x	1.86	x	108.01	x	0.65	x	0.7	=	246.81	(78)
South	0.9x	1	x	0.75	x	108.01	x	0.65	x	0.7	=	132.69	(78)
South	0.9x	1	x	1.86	x	104.89	x	0.65	x	0.7	=	239.69	(78)
South	0.9x	1	x	0.75	x	104.89	x	0.65	x	0.7	=	128.86	(78)
South	0.9x	1	x	1.86	x	101.89	x	0.65	x	0.7	=	232.81	(78)
South	0.9x	1	x	0.75	x	101.89	x	0.65	x	0.7	=	125.17	(78)
South	0.9x	1	x	1.86	x	82.59	x	0.65	x	0.7	=	188.71	(78)
South	0.9x	1	x	0.75	x	82.59	x	0.65	x	0.7	=	101.46	(78)
South	0.9x	1	x	1.86	x	55.42	x	0.65	x	0.7	=	126.63	(78)
South	0.9x	1	x	0.75	x	55.42	x	0.65	x	0.7	=	68.08	(78)
South	0.9x	1	x	1.86	x	40.4	x	0.65	x	0.7	=	92.31	(78)
South	0.9x	1	x	0.75	x	40.4	x	0.65	x	0.7	=	49.63	(78)
West	0.9x	1	x	1.2	x	19.64	x	0.65	x	0.7	=	19.3	(80)
West	0.9x	1	x	1.2	x	38.42	x	0.65	x	0.7	=	37.76	(80)
West	0.9x	1	x	1.2	x	63.27	x	0.65	x	0.7	=	62.18	(80)
West	0.9x	1	x	1.2	x	92.28	x	0.65	x	0.7	=	90.69	(80)
West	0.9x	1	x	1.2	x	113.09	x	0.65	x	0.7	=	111.15	(80)
West	0.9x	1	x	1.2	x	115.77	x	0.65	x	0.7	=	113.78	(80)
West	0.9x	1	x	1.2	x	110.22	x	0.65	x	0.7	=	108.32	(80)
West	0.9x	1	x	1.2	x	94.68	x	0.65	x	0.7	=	93.05	(80)
West	0.9x	1	x	1.2	x	73.59	x	0.65	x	0.7	=	72.32	(80)
West	0.9x	1	x	1.2	x	45.59	x	0.65	x	0.7	=	44.81	(80)
West	0.9x	1	x	1.2	x	24.49	x	0.65	x	0.7	=	24.07	(80)
West	0.9x	1	x	1.2	x	16.15	x	0.65	x	0.7	=	15.87	(80)
Rooflights	0.9x	1	x	2.49	x	26	x	0.65	x	0.7	=	26.51	(82)
Rooflights	0.9x	1	x	3.35	x	26	x	0.65	x	0.7	=	35.67	(82)
Rooflights	0.9x	1	x	2.49	x	54	x	0.65	x	0.7	=	55.06	(82)
Rooflights	0.9x	1	x	3.35	x	54	x	0.65	x	0.7	=	74.08	(82)
Rooflights	0.9x	1	x	2.49	x	96	x	0.65	x	0.7	=	97.89	(82)
Rooflights	0.9x	1	x	3.35	x	96	x	0.65	x	0.7	=	131.7	(82)
Rooflights	0.9x	1	x	2.49	x	150	x	0.65	x	0.7	=	152.95	(82)
Rooflights	0.9x	1	x	3.35	x	150	x	0.65	x	0.7	=	205.77	(82)
Rooflights	0.9x	1	x	2.49	x	192	x	0.65	x	0.7	=	195.77	(82)
Rooflights	0.9x	1	x	3.35	x	192	x	0.65	x	0.7	=	263.39	(82)
Rooflights	0.9x	1	x	2.49	x	200	x	0.65	x	0.7	=	203.93	(82)
Rooflights	0.9x	1	x	3.35	x	200	x	0.65	x	0.7	=	274.36	(82)
Rooflights	0.9x	1	x	2.49	x	189	x	0.65	x	0.7	=	192.71	(82)
Rooflights	0.9x	1	x	3.35	x	189	x	0.65	x	0.7	=	259.27	(82)
Rooflights	0.9x	1	x	2.49	x	157	x	0.65	x	0.7	=	160.09	(82)

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SAP WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	3.35	x	157	x	0.65	x	0.7	=	215.38	(82)
Rooflights 0.9x	1	x	2.49	x	115	x	0.65	x	0.7	=	117.26	(82)
Rooflights 0.9x	1	x	3.35	x	115	x	0.65	x	0.7	=	157.76	(82)
Rooflights 0.9x	1	x	2.49	x	66	x	0.65	x	0.7	=	67.3	(82)
Rooflights 0.9x	1	x	3.35	x	66	x	0.65	x	0.7	=	90.54	(82)
Rooflights 0.9x	1	x	2.49	x	33	x	0.65	x	0.7	=	33.65	(82)
Rooflights 0.9x	1	x	3.35	x	33	x	0.65	x	0.7	=	45.27	(82)
Rooflights 0.9x	1	x	2.49	x	21	x	0.65	x	0.7	=	21.41	(82)
Rooflights 0.9x	1	x	3.35	x	21	x	0.65	x	0.7	=	28.81	(82)

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

(83)m=	347.76	634.86	963.45	1323.1	1578.65	1604.04	1531.57	1339.07	1089.7	728.97	424.71	292.08	(83)

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

(84)m=	1226.86	1508.53	1807.72	2121.34	2328.91	2220.41	2123.51	1940.79	1718.23	1495.23	1242.48	1149.62	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.85	0.73	0.59	0.65	0.85	0.96	0.99	0.99	(86)

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

(87)m=	18.61	18.87	19.31	19.92	20.42	20.77	20.92	20.89	20.59	19.94	19.2	18.62	(87)

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

(88)m=	19.83	19.84	19.85	19.89	19.9	19.94	19.94	19.94	19.92	19.9	19.88	19.87	(88)

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

(89)m=	0.99	0.98	0.96	0.91	0.81	0.65	0.47	0.53	0.79	0.94	0.98	0.99	(89)

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

(90)m=	17.65	17.92	18.36	18.99	19.47	19.8	19.9	19.89	19.65	19.02	18.28	17.69	(90)

fLA = Living area ÷ (4) = | 0.46 | (91)

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

(92)m=	18.1	18.36	18.8	19.42	19.91	20.25	20.37	20.36	20.08	19.45	18.71	18.12	(92)

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

(93)m=	18.7	18.96	19.4	20.02	20.51	20.85	20.97	20.96	20.68	20.05	19.31	18.72	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.92	0.83	0.72	0.59	0.64	0.83	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1213.26	1477.86	1735.48	1941.76	1942.64	1598.39	1246.37	1244.6	1433.54	1412.58	1220.33	1139.25	(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=	5070.75	4914.07	4473.78	3712.45	2919.91	2001.68	1400.41	1449.2	2136.27	3132.34	4106.2	4957.23	(97)

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SAP WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	2869.98	2309.13	2037.29	1274.89	727.09	0	0	0	0	1279.5	2077.83	2840.57		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 15416.28 | (98)

Space heating requirement in kWh/m²/year | 102.33 | (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		61	(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)	2869.98	2309.13	2037.29	1274.89	727.09	0	0	0	0	1279.5	2077.83	2840.57		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	4704.88	3785.46	3339.83	2089.99	1191.94	0	0	0	0	2097.54	3406.27	4656.68		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													25272.59	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	458.56	409.33	442.04	413.1	417.03	307.84	306.32	321.42	316.24	427.54	430.9	453.21		
Efficiency of water heater													51	(216)
(217)m=	59.4	59.25	58.94	58.21	56.93	51	51	51	51	58.14	59.01	59.4		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	772.04	690.85	749.98	709.71	732.51	603.61	600.63	630.23	620.08	735.3	730.18	763.01		
Total = Sum(219a)$_{1...12}$ =													8338.13	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			25272.59	
Water heating fuel used			8338.13	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)
Electricity for lighting			505.86	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

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SAP WorkSheet: New dwelling design stage

Space heating - main system 1	(211)	x	3.48	x 0.01 =	879.49	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	290.17	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	26.51	(249)

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

Energy for lighting	(232)		13.19	x 0.01 =	66.72	(250)
Additional standing charges (Table 12)					120	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	1382.89	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.97	(257)
SAP rating (Section 12)		58.59	(258)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	5458.88	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1801.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =				7259.92	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	104.32	(267)
Electricity for lighting	(232)	x	0.519	=	262.54	(268)
Total CO2, kg/year			sum of (265)…(271) =		7626.78	(272)
CO2 emissions per m²			(272) ÷ (4) =		50.63	(273)
EI rating (section 14)					49	(274)

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13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	30832.56	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	10172.52	(264)
Space and water heating	(261) + (262) + (263) + (264) =				41005.08	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	617.07	(267)
Electricity for lighting	(232)	x	0	=	1553.01	(268)
‘Total Primary Energy			sum of (265)…(271) =		43175.16	(272)

Primary energy kWh/m²/year	(272) ÷ (4) =	286.59	(273)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	40.62	(1a) x	3.2	(2a) =	129.98	(3a)
First floor	110.03	(1b) x	2.65	(2b) =	291.58	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150.65	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	421.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.19	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.94	(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) =	0.8	(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

DER WorkSheet: New dwelling design stage

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

1.02	1	0.98	0.88	0.86	0.76	0.76	0.74	0.8	0.86	0.9	0.94

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=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(24d)

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

(25)m=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(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	2	=	4.2			(26)
Windows Type 1			1.86	x1/[1/(4.5)+ 0.04]		=	7.09			(27)
Windows Type 2			0.75	x1/[1/(4.5)+ 0.04]		=	2.86			(27)
Windows Type 3			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 4			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 5			8.4	x1/[1/(4.5)+ 0.04]		=	32.03			(27)
Rooflights Type 1			2.49	x1/[1/(4.5) + 0.04]		=	11.205			(27b)
Rooflights Type 2			3.35	x1/[1/(4.5) + 0.04]		=	15.075			(27b)
Walls Type1	26.06	5.58	20.48	x	0.45	=	9.21			(29)
Walls Type2	21.14	0	21.14	x	0.2	=	4.31			(29)
Walls Type3	80.03	16.2	63.83	x	0.45	=	28.72			(29)
Roof	110.03	0	110.03	x	0.2	=	22.01			(30)
Total area of elements, m²			245.2							(31)
Party wall			48.1	x	0	=	0			(32)
Party wall			22.83	x	0	=	0			(32)

** 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) = 173.79 (33)

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DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		36.78	(36)

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

Total fabric heat loss	(33) + (36) =	210.57	(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=	141.69	138.91	136.16	123.26	120.85	109.61	109.61	107.53	113.94	120.85	125.73	130.84	(38)

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

(39)m=	352.25	349.48	346.73	333.83	331.42	320.18	320.18	318.1	324.51	331.42	336.3	341.4	

Average = Sum(39)1…12 /12= 333.82 (39)

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

(40)m=	2.34	2.32	2.3	2.22	2.2	2.13	2.13	2.11	2.15	2.2	2.23	2.27	

Average = Sum(40)1…12 /12= 2.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.94 (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 — 103.91 (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=	114.3	110.15	105.99	101.83	97.68	93.52	93.52	97.68	101.83	105.99	110.15	114.3	

Total = Sum(44)1…12 = 1246.93 (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=	169.51	148.25	152.98	133.37	127.98	110.43	102.33	117.43	118.83	138.49	151.17	164.16	

Total = Sum(45)1…12 = 1634.92 (45)

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

(46)m=	25.43	22.24	22.95	20.01	19.2	16.56	15.35	17.61	17.82	20.77	22.68	24.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 250 (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) =	250	(50)

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

DER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.03	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0.78	(52)
Temperature factor from Table 2b	0.78	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	5.18	(54)
Enter (50) or (54) in (55)	5.18	(55)

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

(56)m=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	160.68	145.13	160.68	155.49	160.68	155.49	160.68	160.68	155.49	160.68	155.49	160.68	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(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=	458.56	409.33	442.04	413.1	417.03	307.84	306.32	321.42	316.24	427.54	430.9	453.21	(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=	458.56	409.33	442.04	413.1	417.03	307.84	306.32	321.42	316.24	427.54	430.9	453.21	

Output from water heater (annual)$_{1…12}$ — 4703.52 — (64)

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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=	159.06	142.06	153.57	143.74	145.25	70.25	68.68	73.7	73.04	148.75	149.65	157.28	(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=	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	(66)

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

(67)m=	28.99	25.75	20.94	15.85	11.85	10.01	10.81	14.05	18.86	23.95	27.95	29.8	(67)

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

(68)m=	321.23	324.56	316.16	298.28	275.71	254.49	240.32	236.98	245.38	263.27	285.84	307.06	(68)

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

(69)m=	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	(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=	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	(71)

Water heating gains (Table 5)

(72)m=	213.79	211.39	206.41	199.63	195.23	97.57	92.31	99.05	101.45	199.93	207.85	211.4	(72)

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

(73)m=	631.04	628.73	610.54	580.79	549.82	429.1	410.46	417.12	432.72	554.17	588.67	615.28	(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	1.2	x	10.63	x	0.85	x	0.7	=	10.52	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.85	x	0.7	=	20.11	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.85	x	0.7	=	34.17	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.85	x	0.7	=	54.89	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.85	x	0.7	=	73.94	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.85	x	0.7	=	79.15	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.85	x	0.7	=	73.9	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.85	x	0.7	=	58.63	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.85	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.85	x	0.7	=	23.94	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.85	x	0.7	=	12.98	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.85	x	0.7	=	8.77	(74)
East	0.9x	1	x	8.4	x	19.64	x	0.85	x	0.7	=	68.03	(76)
East	0.9x	1	x	8.4	x	38.42	x	0.85	x	0.7	=	133.07	(76)
East	0.9x	1	x	8.4	x	63.27	x	0.85	x	0.7	=	219.15	(76)
East	0.9x	1	x	8.4	x	92.28	x	0.85	x	0.7	=	319.62	(76)
East	0.9x	1	x	8.4	x	113.09	x	0.85	x	0.7	=	391.71	(76)
East	0.9x	1	x	8.4	x	115.77	x	0.85	x	0.7	=	400.98	(76)
East	0.9x	1	x	8.4	x	110.22	x	0.85	x	0.7	=	381.75	(76)
East	0.9x	1	x	8.4	x	94.68	x	0.85	x	0.7	=	327.92	(76)
East	0.9x	1	x	8.4	x	73.59	x	0.85	x	0.7	=	254.88	(76)
East	0.9x	1	x	8.4	x	45.59	x	0.85	x	0.7	=	157.9	(76)
East	0.9x	1	x	8.4	x	24.49	x	0.85	x	0.7	=	84.82	(76)
East	0.9x	1	x	8.4	x	16.15	x	0.85	x	0.7	=	55.94	(76)
South	0.9x	0.77	x	1.86	x	46.75	x	0.65	x	0.7	=	82.26	(78)
South	0.9x	0.77	x	0.75	x	46.75	x	0.65	x	0.7	=	44.22	(78)
South	0.9x	0.77	x	1.86	x	76.57	x	0.65	x	0.7	=	134.72	(78)
South	0.9x	0.77	x	0.75	x	76.57	x	0.65	x	0.7	=	72.43	(78)
South	0.9x	0.77	x	1.86	x	97.53	x	0.65	x	0.7	=	171.61	(78)
South	0.9x	0.77	x	0.75	x	97.53	x	0.65	x	0.7	=	92.26	(78)
South	0.9x	0.77	x	1.86	x	110.23	x	0.65	x	0.7	=	193.95	(78)
South	0.9x	0.77	x	0.75	x	110.23	x	0.65	x	0.7	=	104.28	(78)
South	0.9x	0.77	x	1.86	x	114.87	x	0.65	x	0.7	=	202.11	(78)
South	0.9x	0.77	x	0.75	x	114.87	x	0.65	x	0.7	=	108.66	(78)

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DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.86	x	110.55	x	0.65	x	0.7	=	194.5	(78)
South	0.9x	0.77	x	0.75	x	110.55	x	0.65	x	0.7	=	104.57	(78)
South	0.9x	0.77	x	1.86	x	108.01	x	0.65	x	0.7	=	190.04	(78)
South	0.9x	0.77	x	0.75	x	108.01	x	0.65	x	0.7	=	102.17	(78)
South	0.9x	0.77	x	1.86	x	104.89	x	0.65	x	0.7	=	184.56	(78)
South	0.9x	0.77	x	0.75	x	104.89	x	0.65	x	0.7	=	99.22	(78)
South	0.9x	0.77	x	1.86	x	101.89	x	0.65	x	0.7	=	179.26	(78)
South	0.9x	0.77	x	0.75	x	101.89	x	0.65	x	0.7	=	96.38	(78)
South	0.9x	0.77	x	1.86	x	82.59	x	0.65	x	0.7	=	145.31	(78)
South	0.9x	0.77	x	0.75	x	82.59	x	0.65	x	0.7	=	78.12	(78)
South	0.9x	0.77	x	1.86	x	55.42	x	0.65	x	0.7	=	97.5	(78)
South	0.9x	0.77	x	0.75	x	55.42	x	0.65	x	0.7	=	52.42	(78)
South	0.9x	0.77	x	1.86	x	40.4	x	0.65	x	0.7	=	71.08	(78)
South	0.9x	0.77	x	0.75	x	40.4	x	0.65	x	0.7	=	38.21	(78)
West	0.9x	0.77	x	1.2	x	19.64	x	0.65	x	0.7	=	14.86	(80)
West	0.9x	0.77	x	1.2	x	38.42	x	0.65	x	0.7	=	29.07	(80)
West	0.9x	0.77	x	1.2	x	63.27	x	0.65	x	0.7	=	47.88	(80)
West	0.9x	0.77	x	1.2	x	92.28	x	0.65	x	0.7	=	69.83	(80)
West	0.9x	0.77	x	1.2	x	113.09	x	0.65	x	0.7	=	85.58	(80)
West	0.9x	0.77	x	1.2	x	115.77	x	0.65	x	0.7	=	87.61	(80)
West	0.9x	0.77	x	1.2	x	110.22	x	0.65	x	0.7	=	83.41	(80)
West	0.9x	0.77	x	1.2	x	94.68	x	0.65	x	0.7	=	71.65	(80)
West	0.9x	0.77	x	1.2	x	73.59	x	0.65	x	0.7	=	55.69	(80)
West	0.9x	0.77	x	1.2	x	45.59	x	0.65	x	0.7	=	34.5	(80)
West	0.9x	0.77	x	1.2	x	24.49	x	0.65	x	0.7	=	18.53	(80)
West	0.9x	0.77	x	1.2	x	16.15	x	0.65	x	0.7	=	12.22	(80)
Rooflights	0.9x	1	x	2.49	x	26	x	0.65	x	0.7	=	26.51	(82)
Rooflights	0.9x	1	x	3.35	x	26	x	0.65	x	0.7	=	35.67	(82)
Rooflights	0.9x	1	x	2.49	x	54	x	0.65	x	0.7	=	55.06	(82)
Rooflights	0.9x	1	x	3.35	x	54	x	0.65	x	0.7	=	74.08	(82)
Rooflights	0.9x	1	x	2.49	x	96	x	0.65	x	0.7	=	97.89	(82)
Rooflights	0.9x	1	x	3.35	x	96	x	0.65	x	0.7	=	131.7	(82)
Rooflights	0.9x	1	x	2.49	x	150	x	0.65	x	0.7	=	152.95	(82)
Rooflights	0.9x	1	x	3.35	x	150	x	0.65	x	0.7	=	205.77	(82)
Rooflights	0.9x	1	x	2.49	x	192	x	0.65	x	0.7	=	195.77	(82)
Rooflights	0.9x	1	x	3.35	x	192	x	0.65	x	0.7	=	263.39	(82)
Rooflights	0.9x	1	x	2.49	x	200	x	0.65	x	0.7	=	203.93	(82)
Rooflights	0.9x	1	x	3.35	x	200	x	0.65	x	0.7	=	274.36	(82)
Rooflights	0.9x	1	x	2.49	x	189	x	0.65	x	0.7	=	192.71	(82)
Rooflights	0.9x	1	x	3.35	x	189	x	0.65	x	0.7	=	259.27	(82)
Rooflights	0.9x	1	x	2.49	x	157	x	0.65	x	0.7	=	160.09	(82)

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Rooflights 0.9x	1	x	3.35	x	157	x	0.65	x	0.7	=	215.38	(82)
Rooflights 0.9x	1	x	2.49	x	115	x	0.65	x	0.7	=	117.26	(82)
Rooflights 0.9x	1	x	3.35	x	115	x	0.65	x	0.7	=	157.76	(82)
Rooflights 0.9x	1	x	2.49	x	66	x	0.65	x	0.7	=	67.3	(82)
Rooflights 0.9x	1	x	3.35	x	66	x	0.65	x	0.7	=	90.54	(82)
Rooflights 0.9x	1	x	2.49	x	33	x	0.65	x	0.7	=	33.65	(82)
Rooflights 0.9x	1	x	3.35	x	33	x	0.65	x	0.7	=	45.27	(82)
Rooflights 0.9x	1	x	2.49	x	21	x	0.65	x	0.7	=	21.41	(82)
Rooflights 0.9x	1	x	3.35	x	21	x	0.65	x	0.7	=	28.81	(82)

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

(83)m=	282.07	518.55	794.66	1101.29	1321.17	1345.12	1283.27	1117.44	902.32	597.61	345.18	236.45	(83)

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

(84)m=	913.12	1147.28	1405.2	1682.09	1870.99	1774.22	1693.73	1534.56	1335.04	1151.78	933.85	851.73	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.96	0.9	0.81	0.69	0.74	0.91	0.98	0.99	1	(86)

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

(87)m=	18.45	18.69	19.12	19.73	20.27	20.68	20.87	20.83	20.46	19.79	19.05	18.47	(87)

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

(88)m=	19.83	19.84	19.85	19.89	19.9	19.94	19.94	19.94	19.92	19.9	19.88	19.87	(88)

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

(89)m=	1	0.99	0.98	0.95	0.88	0.75	0.57	0.63	0.87	0.97	0.99	1	(89)

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

(90)m=	17.49	17.74	18.17	18.81	19.33	19.73	19.88	19.86	19.54	18.87	18.13	17.54	(90)

fLA = Living area ÷ (4) = 0.46 (91)

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

(92)m=	17.94	18.18	18.61	19.24	19.77	20.17	20.34	20.31	19.97	19.3	18.56	17.97	(92)

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

(93)m=	18.54	18.78	19.21	19.84	20.37	20.77	20.94	20.91	20.57	19.9	19.16	18.57	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.89	0.8	0.68	0.74	0.9	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	908.45	1135.59	1374.28	1595.71	1662.91	1419.26	1153.11	1128.38	1197.02	1117.16	925.95	848.31	(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=	5015.34	4851.93	4408.28	3651.68	2873.32	1976.1	1389.48	1434.87	2098.63	3080.73	4054.2	4905.47	(97)

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

(98)m=	3055.53	2497.38	2257.29	1480.3	900.54	0	0	0	0	1460.89	2252.34	3018.52

Total per year (kWh/year) = Sum(98)1...5,9...12 = 16922.8 (98)

Space heating requirement in kWh/m²/year 112.33 (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		61	(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)	3055.53	2497.38	2257.29	1480.3	900.54	0	0	0	0	1460.89	2252.34	3018.52		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	5009.07	4094.07	3700.48	2426.72	1476.3	0	0	0	0	2394.91	3692.36	4948.4		(211)
Total (kWh/year) =Sum(211)1...5,10....12 =													27742.29	(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)	458.56	409.33	442.04	413.1	417.03	307.84	306.32	321.42	316.24	427.54	430.9	453.21		
Efficiency of water heater													51	(216)
(217)m=	59.48	59.36	59.1	58.5	57.44	51	51	51	51	58.41	59.14	59.48		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	770.97	689.56	747.92	706.19	726.08	603.61	600.63	630.23	620.08	732	728.63	761.99		
Total = Sum(219a)1...12 =													8317.87	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			27742.29	
Water heating fuel used			8317.87	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		201	(231)
Electricity for lighting			512	(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	=	5992.34	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	1796.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7789	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	104.32	(267)
Electricity for lighting	(232) x	0.519	=	265.73	(268)
Total CO2, kg/year		sum of (265)…(271) =		8159.04	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		54.16	(273)
EI rating (section 14)				46	(274)

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Appendix B - Step Two – 'Be Lean' Output Document and Energy Report Figures

SAP Input

Property Details: Flat 6

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2015

Floor Location:	Floor area:	Storey height:
Basement floor	103.39 m²	3.1 m
Floor 1	110.92 m²	2.6 m

Living area:	50.2 m² (fraction 0.234)
Front of dwelling faces:	Unspecified

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
W1	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
W2	SAP 2012	Windows	Single-glazed	No	
W3	SAP 2012	Windows	Single-glazed	No	
W4	SAP 2012	Windows	Single-glazed	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
W1	16mm or more	0.7	0.65	1.5	1.43	2
W2		0.7	0.65	4.5	3.13	2
W3		0.7	0.85	4.5	2.5	1
W4		0.7	0.65	4.5	3.13	2
RF1	16mm or more	0.7	0.65	1.5	3.6	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
W1		Basement wall	North	0.95	1.5
W2		External wall	North	1.25	2.5
W3		External wall	West	1	2.5
W4		External wall	North	1.25	2.5
RF1		flat roof	Horizontal	4.5	0.8

Overshading:	More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Basement wall	64.17	2.86	61.31	0.15	0	False	N/A
External wall	62.4	15.02	47.38	0.85	0	False	N/A
corridor	33.67	2.1	31.57	0.2	0.9	False	N/A

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flat roof	7.68	3.6	4.08	0.15	0	N/A
Basement floor	103.39			0.17		N/A
<u>Internal Elements</u>						
<u>Party Elements</u>						
party wall Basement	53.32					N/A
party ff	39.78					N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	No (Assumed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	4
Pressure test:	15

Main heating system:

Main heating system:
Community heating schemes
Heat source: Community boilers
heat from boilers – mains gas, heat fraction 1, efficiency 91
Piping>=1991, pre-insulated, low temp, variable flow

Main heating Control:

Main heating Control:
Charging system linked to use of community heating, programmer and at least two room thermosta
Control code: 2312

Secondary heating system:

Secondary heating system: None

Space cooling system:

Space cooling system:
Split/multiple systems
Tested data to EN 14511:
Brand/Model: TBC
EER: 3.5
Compressor control: Systems with On/Off control
Cooled area: 140 (fraction 0.653)

Water heating:

Water heating:
From main heating system
Water code: 901
Fuel :heat from boilers – mains gas
Hot water cylinder
Cylinder volume: 250 litres
Cylinder insulation: Jacket 35 mm
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No

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Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 6

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	103.39	(1a)	x	3.1	(2a)	=	320.51	(3a)
Ground floor	110.92	(1b)	x	2.6	(2b)	=	288.39	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	214.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	608.9	(5)

2. Ventilation rate:

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

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.05	(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		15	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.8	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.56	(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

SAP WorkSheet: New dwelling design stage

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

0.71	0.7	0.69	0.62	0.6	0.53	0.53	0.52	0.56	0.6	0.63	0.66

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=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(24d)

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

(25)m=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(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	2	=	4.2			(26)
Windows Type 1			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Windows Type 2			3.13	x1/[1/(4.5)+ 0.04]		=	11.94			(27)
Windows Type 3			2.5	x1/[1/(4.5)+ 0.04]		=	9.53			(27)
Windows Type 4			3.13	x1/[1/(4.5)+ 0.04]		=	11.94			(27)
Rooflights			3.6	x1/[1/(1.5) + 0.04]		=	5.4			(27b)
Floor			103.39	x	0.17	=	17.5763			(28)
Walls Type1	64.17	2.86	61.31	x	0.15	=	9.2			(29)
Walls Type2	62.4	15.02	47.38	x	0.85	=	40.27			(29)
Walls Type3	33.67	2.1	31.57	x	0.17	=	5.35			(29)
Roof	7.68	3.6	4.08	x	0.15	=	0.61			(30)
Total area of elements, m²			271.31							(31)
Party wall			53.32	x	0	=	0			(32)
Party wall			39.78	x	0	=	0			(32)

** 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) = 143.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 40.7 | (36)

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

Total fabric heat loss (33) + (36) = | 184.33 | (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=	151.59	149.61	147.66	138.52	136.81	128.85	128.85	127.38	131.92	136.81	140.27	143.89	(38)

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

(39)m=	335.92	333.93	331.99	322.85	321.14	313.18	313.18	311.7	316.24	321.14	324.6	328.21	

Average = Sum(39)$_{1\ldots12}$ /12= | 322.84 | (39)

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

(40)m=	1.57	1.56	1.55	1.51	1.5	1.46	1.46	1.45	1.48	1.5	1.51	1.53	

Average = Sum(40)$_{1\ldots12}$ /12= | 1.51 | (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:

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Assumed occupancy, N | 3.02 | (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 | 105.94 | (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=	116.53	112.29	108.06	103.82	99.58	95.34	95.34	99.58	103.82	108.06	112.29	116.53	

Total = Sum(44)$_{1\ldots12}$ = | 1271.25 | (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=	172.81	151.14	155.97	135.98	130.47	112.59	104.33	119.72	121.15	141.19	154.12	167.36	

Total = Sum(45)$_{1\ldots12}$ = | 1666.81 | (45)

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

(46)m=	25.92	22.67	23.39	20.4	19.57	16.89	15.65	17.96	18.17	21.18	23.12	25.1	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 250 | (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) = | 250 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.04 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0.78 | (52)

Temperature factor from Table 2b | 0.6 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	4.91	(54)
Enter (50) or (54) in (55)		4.91	(55)

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

(56)m=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	348.33	309.68	331.49	305.84	305.99	282.45	279.85	295.24	291.01	316.71	323.98	342.88	(62)

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

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

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

Output from water heater

(64)m=	348.33	309.68	331.49	305.84	305.99	282.45	279.85	295.24	291.01	316.71	323.98	342.88	

Output from water heater (annual)$_{1…12}$ | 3733.44 | (64)

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

(65)m=	197.88	177.08	192.28	181.1	183.8	173.32	175.11	180.22	176.17	187.36	187.13	196.06	(65)

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

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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=	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	181.23	(66)

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

(67)m=	95.45	84.78	68.95	52.2	39.02	32.94	35.59	46.27	62.1	78.85	92.03	98.1	(67)

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

(68)m=	573.81	579.76	564.76	532.81	492.49	454.59	429.27	423.32	438.33	470.27	510.59	548.49	(68)

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

(69)m=	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	56.14	(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=	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	(71)

Water heating gains (Table 5)

(72)m=	265.96	263.52	258.44	251.53	247.04	240.73	235.36	242.24	244.68	251.83	259.9	263.53	(72)

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

(73)m=	1051.78	1044.61	1008.69	953.09	895.1	844.81	816.78	828.38	861.66	917.5	979.08	1026.68	(73)

6. Solar gains:

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

SAP WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.3	x	1.43	x	10.63	x	0.65	x	0.7	=	3.74	(74)
North	0.9x	1	x	3.13	x	10.63	x	0.65	x	0.7	=	27.26	(74)
North	0.9x	1	x	3.13	x	10.63	x	0.65	x	0.7	=	27.26	(74)
North	0.9x	0.3	x	1.43	x	20.32	x	0.65	x	0.7	=	7.14	(74)
North	0.9x	1	x	3.13	x	20.32	x	0.65	x	0.7	=	52.09	(74)
North	0.9x	1	x	3.13	x	20.32	x	0.65	x	0.7	=	52.09	(74)
North	0.9x	0.3	x	1.43	x	34.53	x	0.65	x	0.7	=	12.13	(74)
North	0.9x	1	x	3.13	x	34.53	x	0.65	x	0.7	=	88.52	(74)
North	0.9x	1	x	3.13	x	34.53	x	0.65	x	0.7	=	88.52	(74)
North	0.9x	0.3	x	1.43	x	55.46	x	0.65	x	0.7	=	19.49	(74)
North	0.9x	1	x	3.13	x	55.46	x	0.65	x	0.7	=	142.18	(74)
North	0.9x	1	x	3.13	x	55.46	x	0.65	x	0.7	=	142.18	(74)
North	0.9x	0.3	x	1.43	x	74.72	x	0.65	x	0.7	=	26.25	(74)
North	0.9x	1	x	3.13	x	74.72	x	0.65	x	0.7	=	191.53	(74)
North	0.9x	1	x	3.13	x	74.72	x	0.65	x	0.7	=	191.53	(74)
North	0.9x	0.3	x	1.43	x	79.99	x	0.65	x	0.7	=	28.1	(74)
North	0.9x	1	x	3.13	x	79.99	x	0.65	x	0.7	=	205.04	(74)
North	0.9x	1	x	3.13	x	79.99	x	0.65	x	0.7	=	205.04	(74)
North	0.9x	0.3	x	1.43	x	74.68	x	0.65	x	0.7	=	26.24	(74)
North	0.9x	1	x	3.13	x	74.68	x	0.65	x	0.7	=	191.43	(74)
North	0.9x	1	x	3.13	x	74.68	x	0.65	x	0.7	=	191.43	(74)
North	0.9x	0.3	x	1.43	x	59.25	x	0.65	x	0.7	=	20.82	(74)
North	0.9x	1	x	3.13	x	59.25	x	0.65	x	0.7	=	151.88	(74)
North	0.9x	1	x	3.13	x	59.25	x	0.65	x	0.7	=	151.88	(74)
North	0.9x	0.3	x	1.43	x	41.52	x	0.65	x	0.7	=	14.59	(74)
North	0.9x	1	x	3.13	x	41.52	x	0.65	x	0.7	=	106.43	(74)
North	0.9x	1	x	3.13	x	41.52	x	0.65	x	0.7	=	106.43	(74)
North	0.9x	0.3	x	1.43	x	24.19	x	0.65	x	0.7	=	8.5	(74)
North	0.9x	1	x	3.13	x	24.19	x	0.65	x	0.7	=	62.01	(74)
North	0.9x	1	x	3.13	x	24.19	x	0.65	x	0.7	=	62.01	(74)
North	0.9x	0.3	x	1.43	x	13.12	x	0.65	x	0.7	=	4.61	(74)
North	0.9x	1	x	3.13	x	13.12	x	0.65	x	0.7	=	33.63	(74)
North	0.9x	1	x	3.13	x	13.12	x	0.65	x	0.7	=	33.63	(74)
North	0.9x	0.3	x	1.43	x	8.86	x	0.65	x	0.7	=	3.11	(74)
North	0.9x	1	x	3.13	x	8.86	x	0.65	x	0.7	=	22.72	(74)
North	0.9x	1	x	3.13	x	8.86	x	0.65	x	0.7	=	22.72	(74)
West	0.9x	0.54	x	2.5	x	19.64	x	0.85	x	0.7	=	14.2	(80)
West	0.9x	0.54	x	2.5	x	38.42	x	0.85	x	0.7	=	27.78	(80)
West	0.9x	0.54	x	2.5	x	63.27	x	0.85	x	0.7	=	45.74	(80)

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West	0.9x	0.54	x	2.5	x	92.28	x	0.85	x	0.7	=	66.71	(80)
West	0.9x	0.54	x	2.5	x	113.09	x	0.85	x	0.7	=	81.76	(80)
West	0.9x	0.54	x	2.5	x	115.77	x	0.85	x	0.7	=	83.69	(80)
West	0.9x	0.54	x	2.5	x	110.22	x	0.85	x	0.7	=	79.68	(80)
West	0.9x	0.54	x	2.5	x	94.68	x	0.85	x	0.7	=	68.44	(80)
West	0.9x	0.54	x	2.5	x	73.59	x	0.85	x	0.7	=	53.2	(80)
West	0.9x	0.54	x	2.5	x	45.59	x	0.85	x	0.7	=	32.96	(80)
West	0.9x	0.54	x	2.5	x	24.49	x	0.85	x	0.7	=	17.7	(80)
West	0.9x	0.54	x	2.5	x	16.15	x	0.85	x	0.7	=	11.68	(80)
Rooflights	0.9x	1	x	3.6	x	26	x	0.65	x	0.7	=	38.33	(82)
Rooflights	0.9x	1	x	3.6	x	54	x	0.65	x	0.7	=	79.61	(82)
Rooflights	0.9x	1	x	3.6	x	96	x	0.65	x	0.7	=	141.52	(82)
Rooflights	0.9x	1	x	3.6	x	150	x	0.65	x	0.7	=	221.13	(82)
Rooflights	0.9x	1	x	3.6	x	192	x	0.65	x	0.7	=	283.05	(82)
Rooflights	0.9x	1	x	3.6	x	200	x	0.65	x	0.7	=	294.84	(82)
Rooflights	0.9x	1	x	3.6	x	189	x	0.65	x	0.7	=	278.62	(82)
Rooflights	0.9x	1	x	3.6	x	157	x	0.65	x	0.7	=	231.45	(82)
Rooflights	0.9x	1	x	3.6	x	115	x	0.65	x	0.7	=	169.53	(82)
Rooflights	0.9x	1	x	3.6	x	66	x	0.65	x	0.7	=	97.3	(82)
Rooflights	0.9x	1	x	3.6	x	33	x	0.65	x	0.7	=	48.65	(82)
Rooflights	0.9x	1	x	3.6	x	21	x	0.65	x	0.7	=	30.96	(82)

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

(83)m=	110.78	218.71	376.43	591.69	774.12	816.72	767.4	624.46	450.17	262.77	138.21	91.2	(83)

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

(84)m=	1162.56	1263.32	1385.13	1544.78	1669.22	1661.53	1584.18	1452.84	1311.83	1180.27	1117.29	1117.87	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.87	0.75	0.8	0.95	0.99	1	1	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)													
(87)m=	19.19	19.32	19.6	20.02	20.43	20.77	20.92	20.89	20.61	20.11	19.6	19.2	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
(88)m=	19.64	19.64	19.65	19.68	19.69	19.72	19.72	19.72	19.71	19.69	19.68	19.66	(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)													
(89)m=	1	1	0.99	0.98	0.93	0.79	0.58	0.65	0.9	0.99	1	1	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m=	17.26	17.45	17.86	18.5	19.08	19.54	19.68	19.67	19.35	18.63	17.89	17.29	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

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

SAP WorkSheet: New dwelling design stage

(92)m=	17.71	17.89	18.27	18.85	19.4	19.83	19.97	19.95	19.65	18.97	18.29	17.74	(92)

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

(93)m=	17.71	17.89	18.27	18.85	19.4	19.83	19.97	19.95	19.65	18.97	18.29	17.74	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.92	0.8	0.62	0.69	0.9	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1158.48	1256.63	1370.75	1503.16	1543.25	1330.38	982.23	995.75	1183.56	1157.1	1110.8	1114.62	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	4504.22	4338.48	3906.8	3213.34	2471.21	1637.94	1056.37	1107.94	1753.97	2689.46	3632.58	4442.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2489.23	2071	1886.82	1231.33	690.41	0	0	0	0	1140.08	1815.68	2475.89	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 13800.45 (98)

Space heating requirement in kWh/m²/year 64.39 (99)

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8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	2943.87	2317.52	2368.95	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.55	0.64	0.59	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1626.75	1493.61	1400.32	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1705.06	1625.29	1487	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.65 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(107)$_{6...8}$ = 0 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0 (108)

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)

SAP WorkSheet: New dwelling design stage

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		13800.45	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	14490.47	(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		3733.44	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	3920.11	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	184.11	(313)
Cooling System Energy Efficiency Ratio		4.38	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		674.28	(332)

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10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	4.24	x 0.01 =	614.4	(340a)
Water heating from CHP	(310a) x	4.24	x 0.01 =	166.21	(342a)
		Fuel Price			
Pumps and fans	(331)	13.19	x 0.01 =	0	(349)
Energy for lighting	(332)	13.19	x 0.01 =	88.94	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			989.55	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)	0.42	(356)

SAP WorkSheet: New dwelling design stage

Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =			1.6	(357)
SAP rating (section12)				77.64	(358)

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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	4369.98	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	95.55	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	4465.54	(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) =				4465.54	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	349.95	(379)
Total CO2, kg/year	sum of (376)…(382) =				4815.49	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				22.47	(384)
EI rating (section 14)					75.12	(385)

13b. Primary Energy – Community heating scheme

		Energy kWh/year	Primary factor		P.Energy kWh/year	
Energy 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				91	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	24682.32	(367)
Electrical energy for heat distribution	[(313) x			=	565.2	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	25247.53	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					25247.53	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				25247.53	(376)
Energy associated with space cooling	(315) x		3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	0	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	2070.05	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =				27317.57	(383)

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DER WorkSheet: New dwelling design stage

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 6

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	103.39	(1a)	x	3.1	(2a)	=	320.51	(3a)
Ground floor	110.92	(1b)	x	2.6	(2b)	=	288.39	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	214.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	608.9	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.05	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.8	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.56	(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

DER WorkSheet: New dwelling design stage

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

0.71	0.7	0.69	0.62	0.6	0.53	0.53	0.52	0.56	0.6	0.63	0.66

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=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(24d)

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

(25)m=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.72	(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	2	=	4.2			(26)
Windows Type 1			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Windows Type 2			3.13	x1/[1/(4.5)+ 0.04]		=	11.94			(27)
Windows Type 3			2.5	x1/[1/(4.5)+ 0.04]		=	9.53			(27)
Windows Type 4			3.13	x1/[1/(4.5)+ 0.04]		=	11.94			(27)
Rooflights			3.6	x1/[1/(1.5) + 0.04]		=	5.4			(27b)
Floor			103.39	x	0.17	=	17.5763			(28)
Walls Type1	64.17	2.86	61.31	x	0.15	=	9.2			(29)
Walls Type2	62.4	15.02	47.38	x	0.85	=	40.27			(29)
Walls Type3	33.67	2.1	31.57	x	0.17	=	5.35			(29)
Roof	7.68	3.6	4.08	x	0.15	=	0.61			(30)
Total area of elements, m²			271.31							(31)
Party wall			53.32	x	0	=	0			(32)
Party wall			39.78	x	0	=	0			(32)

** 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) = 143.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 40.7 | (36)

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

Total fabric heat loss (33) + (36) = | 184.33 | (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=	151.59	149.61	147.66	138.52	136.81	128.85	128.85	127.38	131.92	136.81	140.27	143.89	(38)

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

(39)m=	335.92	333.93	331.99	322.85	321.14	313.18	313.18	311.7	316.24	321.14	324.6	328.21	

Average = Sum(39)$_{1…12}$ /12= | 322.84 | (39)

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

(40)m=	1.57	1.56	1.55	1.51	1.5	1.46	1.46	1.45	1.48	1.5	1.51	1.53	

Average = Sum(40)$_{1…12}$ /12= | 1.51 | (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 | 3.02 | (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 | 105.94 | (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=	116.53	112.29	108.06	103.82	99.58	95.34	95.34	99.58	103.82	108.06	112.29	116.53	

Total = Sum(44)$_{1…12}$ = | 1271.25 | (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=	172.81	151.14	155.97	135.98	130.47	112.59	104.33	119.72	121.15	141.19	154.12	167.36	

Total = Sum(45)$_{1…12}$ = | 1666.81 | (45)

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

(46)m=	25.92	22.67	23.39	20.4	19.57	16.89	15.65	17.96	18.17	21.18	23.12	25.1	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 250 | (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) = | 250 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.04 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0.78 | (52)

Temperature factor from Table 2b | 0.6 | (53)

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DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	4.91	(54)
Enter (50) or (54) in (55)		4.91	(55)

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

(56)m=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	348.33	309.68	331.49	305.84	305.99	282.45	279.85	295.24	291.01	316.71	323.98	342.88	(62)

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

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

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

Output from water heater

(64)m=	348.33	309.68	331.49	305.84	305.99	282.45	279.85	295.24	291.01	316.71	323.98	342.88	

Output from water heater (annual)1…12 — 3733.44 — (64)

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

(65)m=	197.88	177.08	192.28	181.1	183.8	173.32	175.11	180.22	176.17	187.36	187.13	196.06	(65)

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

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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=	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	151.03	(66)

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

(67)m=	39.2	34.82	28.32	21.44	16.02	13.53	14.62	19	25.5	32.38	37.8	40.29	(67)

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

(68)m=	384.45	388.44	378.39	356.98	329.97	304.58	287.61	283.62	293.68	315.08	342.1	367.49	(68)

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

(69)m=	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	(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=	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	-120.82	(71)

Water heating gains (Table 5)

(72)m=	265.96	263.52	258.44	251.53	247.04	240.73	235.36	242.24	244.68	251.83	259.9	263.53	(72)

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

(73)m=	757.92	755.08	733.45	698.26	661.34	627.14	605.9	613.17	632.17	667.6	708.1	739.61	(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)	
North	0.9x	0.3	x	1.43	x	10.63	x	0.65	x	0.7	=	3.74	(74)
North	0.9x	0.77	x	3.13	x	10.63	x	0.65	x	0.7	=	20.99	(74)
North	0.9x	0.77	x	3.13	x	10.63	x	0.65	x	0.7	=	20.99	(74)
North	0.9x	0.3	x	1.43	x	20.32	x	0.65	x	0.7	=	7.14	(74)
North	0.9x	0.77	x	3.13	x	20.32	x	0.65	x	0.7	=	40.11	(74)
North	0.9x	0.77	x	3.13	x	20.32	x	0.65	x	0.7	=	40.11	(74)
North	0.9x	0.3	x	1.43	x	34.53	x	0.65	x	0.7	=	12.13	(74)
North	0.9x	0.77	x	3.13	x	34.53	x	0.65	x	0.7	=	68.16	(74)
North	0.9x	0.77	x	3.13	x	34.53	x	0.65	x	0.7	=	68.16	(74)
North	0.9x	0.3	x	1.43	x	55.46	x	0.65	x	0.7	=	19.49	(74)
North	0.9x	0.77	x	3.13	x	55.46	x	0.65	x	0.7	=	109.48	(74)
North	0.9x	0.77	x	3.13	x	55.46	x	0.65	x	0.7	=	109.48	(74)
North	0.9x	0.3	x	1.43	x	74.72	x	0.65	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	3.13	x	74.72	x	0.65	x	0.7	=	147.48	(74)
North	0.9x	0.77	x	3.13	x	74.72	x	0.65	x	0.7	=	147.48	(74)
North	0.9x	0.3	x	1.43	x	79.99	x	0.65	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	3.13	x	79.99	x	0.65	x	0.7	=	157.88	(74)
North	0.9x	0.77	x	3.13	x	79.99	x	0.65	x	0.7	=	157.88	(74)
North	0.9x	0.3	x	1.43	x	74.68	x	0.65	x	0.7	=	26.24	(74)
North	0.9x	0.77	x	3.13	x	74.68	x	0.65	x	0.7	=	147.4	(74)
North	0.9x	0.77	x	3.13	x	74.68	x	0.65	x	0.7	=	147.4	(74)
North	0.9x	0.3	x	1.43	x	59.25	x	0.65	x	0.7	=	20.82	(74)
North	0.9x	0.77	x	3.13	x	59.25	x	0.65	x	0.7	=	116.94	(74)
North	0.9x	0.77	x	3.13	x	59.25	x	0.65	x	0.7	=	116.94	(74)
North	0.9x	0.3	x	1.43	x	41.52	x	0.65	x	0.7	=	14.59	(74)
North	0.9x	0.77	x	3.13	x	41.52	x	0.65	x	0.7	=	81.95	(74)
North	0.9x	0.77	x	3.13	x	41.52	x	0.65	x	0.7	=	81.95	(74)
North	0.9x	0.3	x	1.43	x	24.19	x	0.65	x	0.7	=	8.5	(74)
North	0.9x	0.77	x	3.13	x	24.19	x	0.65	x	0.7	=	47.75	(74)
North	0.9x	0.77	x	3.13	x	24.19	x	0.65	x	0.7	=	47.75	(74)
North	0.9x	0.3	x	1.43	x	13.12	x	0.65	x	0.7	=	4.61	(74)
North	0.9x	0.77	x	3.13	x	13.12	x	0.65	x	0.7	=	25.89	(74)
North	0.9x	0.77	x	3.13	x	13.12	x	0.65	x	0.7	=	25.89	(74)
North	0.9x	0.3	x	1.43	x	8.86	x	0.65	x	0.7	=	3.11	(74)
North	0.9x	0.77	x	3.13	x	8.86	x	0.65	x	0.7	=	17.5	(74)
North	0.9x	0.77	x	3.13	x	8.86	x	0.65	x	0.7	=	17.5	(74)
West	0.9x	0.54	x	2.5	x	19.64	x	0.85	x	0.7	=	14.2	(80)
West	0.9x	0.54	x	2.5	x	38.42	x	0.85	x	0.7	=	27.78	(80)
West	0.9x	0.54	x	2.5	x	63.27	x	0.85	x	0.7	=	45.74	(80)

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West	0.9x	0.54	x	2.5	x	92.28	x	0.85	x	0.7	=	66.71	(80)
West	0.9x	0.54	x	2.5	x	113.09	x	0.85	x	0.7	=	81.76	(80)
West	0.9x	0.54	x	2.5	x	115.77	x	0.85	x	0.7	=	83.69	(80)
West	0.9x	0.54	x	2.5	x	110.22	x	0.85	x	0.7	=	79.68	(80)
West	0.9x	0.54	x	2.5	x	94.68	x	0.85	x	0.7	=	68.44	(80)
West	0.9x	0.54	x	2.5	x	73.59	x	0.85	x	0.7	=	53.2	(80)
West	0.9x	0.54	x	2.5	x	45.59	x	0.85	x	0.7	=	32.96	(80)
West	0.9x	0.54	x	2.5	x	24.49	x	0.85	x	0.7	=	17.7	(80)
West	0.9x	0.54	x	2.5	x	16.15	x	0.85	x	0.7	=	11.68	(80)
Rooflights	0.9x	1	x	3.6	x	26	x	0.65	x	0.7	=	38.33	(82)
Rooflights	0.9x	1	x	3.6	x	54	x	0.65	x	0.7	=	79.61	(82)
Rooflights	0.9x	1	x	3.6	x	96	x	0.65	x	0.7	=	141.52	(82)
Rooflights	0.9x	1	x	3.6	x	150	x	0.65	x	0.7	=	221.13	(82)
Rooflights	0.9x	1	x	3.6	x	192	x	0.65	x	0.7	=	283.05	(82)
Rooflights	0.9x	1	x	3.6	x	200	x	0.65	x	0.7	=	294.84	(82)
Rooflights	0.9x	1	x	3.6	x	189	x	0.65	x	0.7	=	278.62	(82)
Rooflights	0.9x	1	x	3.6	x	157	x	0.65	x	0.7	=	231.45	(82)
Rooflights	0.9x	1	x	3.6	x	115	x	0.65	x	0.7	=	169.53	(82)
Rooflights	0.9x	1	x	3.6	x	66	x	0.65	x	0.7	=	97.3	(82)
Rooflights	0.9x	1	x	3.6	x	33	x	0.65	x	0.7	=	48.65	(82)
Rooflights	0.9x	1	x	3.6	x	21	x	0.65	x	0.7	=	30.96	(82)

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

(83)m=	98.24	194.74	335.71	526.29	686.01	722.4	679.34	554.6	401.22	234.25	122.75	80.74	(83)

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

(84)m=	856.17	949.83	1069.16	1224.55	1347.36	1349.54	1285.24	1167.77	1033.39	901.85	830.85	820.36	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.93	0.83	0.88	0.98	1	1	1	(86)

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

(87)m=	19.06	19.19	19.47	19.89	20.31	20.69	20.87	20.83	20.51	19.99	19.49	19.08	(87)

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

(88)m=	19.64	19.64	19.65	19.68	19.69	19.72	19.72	19.72	19.71	19.69	19.68	19.66	(88)

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

(89)m=	1	1	1	0.99	0.96	0.87	0.68	0.76	0.95	0.99	1	1	(89)

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

(90)m=	17.07	17.27	17.68	18.32	18.92	19.46	19.66	19.63	19.23	18.47	17.72	17.11	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

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

DER WorkSheet: New dwelling design stage

(92)m=	17.54	17.72	18.1	18.69	19.25	19.74	19.94	19.91	19.53	18.83	18.13	17.57	(92)

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

(93)m=	17.54	17.72	18.1	18.69	19.25	19.74	19.94	19.91	19.53	18.83	18.13	17.57	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.96	0.87	0.72	0.78	0.95	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	855.14	947.96	1064.49	1208.62	1290.32	1174.94	920.36	910.81	979.03	894.49	829.15	819.57	(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=	4447.73	4281.14	3849.89	3159.16	2424.52	1611.07	1046.56	1094.24	1716.98	2641.59	3581.33	4388.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2672.89	2239.9	2072.34	1404.39	843.84	0	0	0	0	1299.84	1981.57	2655.24	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 15170 (98)

Space heating requirement in kWh/m²/year 70.79 (99)

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8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	2943.87	2317.52	2368.95	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.54	0.63	0.58	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1593.96	1467.47	1377.81	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1664.94	1587.95	1457.86	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.65 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(107)$_{6...8}$ = 0 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0 (108)

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)

DER WorkSheet: New dwelling design stage

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		15170	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	15928.5	(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		3733.44	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	3920.11	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	198.49	(313)
Cooling System Energy Efficiency Ratio		4.38	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		692.31	(332)

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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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	4711.32	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	103.01	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	4814.33	(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) =				4814.33	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	359.31	(379)

DER WorkSheet: New dwelling design stage

Total CO2, kg/year	sum of (376)…(382) =	5173.64	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	24.14	(384)
EI rating (section 14)		73.26	(385)

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SAP Input

Property Details: Flat 4

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2015

Floor Location:	Floor area:	Storey height:
Basement floor	55.52 m²	3.1 m
Floor 1	83.55 m²	2.6 m
Floor 2	85.82 m²	3.28 m

Living area:	41.96 m² (fraction 0.187)
Front of dwelling faces:	Unspecified

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
W1	SAP 2012	Windows	Single-glazed	No	
W2	Manufacturer	Windows	Single-glazed	No	
W3	SAP 2012	Windows	Single-glazed	No	
W3	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
W1		0.7	0.85	4.5	1.5	3
W2		0.7	0.85	1.5	5	2
W3		0.7	0.85	4.5	1.8	2
W3	16mm or more	0.7	0.85	1.5	6.25	1
RF1	16mm or more	0.7	0.65	1.5	3.45	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
W1		External wall GF	South	1	1.5
W2		External wall GF	North	2	2.5
W3		External wall	North	1	1.8
W3		External wall GF	West	2.5	2.5
RF1		flat roof	Horizontal	2.3	1.5

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:

SAP Input

<u>External Elements</u>							
Basement wall	76.26	0	76.26	0.15	0	False	N/A
External wall GF	80.4	20.75	59.65	0.8	0	False	N/A
corridor GF	13.266	0	13.27	0.2	0.9	False	N/A
Coprridor FF	9.84	0	9.84	0.2	0.9	False	N/A
External FF	69.864	0	69.86	0.8	0	False	N/A
flat roof 1	6	0	6	0.15	0		N/A
Flat roof 2	28.23	0	28.23	0.15	0		N/A
flat roof 3	12.9	0	12.9	0.15	0		N/A
Basement floor	55.52			0.17			N/A
ground floor	28.03			0.2			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
party wall Basement	24.18						N/A
party GF	43.684						N/A
Party wall FF	67.24						N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: No (Assumed)
Ventilation: Natural ventilation (extract fans)
Number of chimneys: 1 (main: 0, secondary: 0, other: 1)
Number of open flues: 0
Number of fans: 4
Number of passive stacks: 0
Number of sides sheltered: 4
Pressure test: 15

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Main heating system:

Main heating system: Community heating schemes
Heat source: Community boilers
heat from boilers – mains gas, heat fraction 1, efficiency 91
Piping>=1991, pre-insulated, low temp, variable flow

Main heating Control:

Main heating Control: Charging system linked to use of community heating, programmer and at least two room thermosta
Control code: 2312

Secondary heating system:

Secondary heating system: None

Space cooling system:

Space cooling system: Split/multiple systems
Tested data to EN 14511:
Brand/Model: TBC
EER: 3.5
Compressor control: Systems with On/Off control
Cooled area: 140 (fraction 0.623)

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :heat from boilers – mains gas
Hot water cylinder
Cylinder volume: 250 litres
Cylinder insulation: Jacket 35 mm
Primary pipework insulation: True
Cylinderstat: True

SAP Input

Cylinder in heated space: True
Solar panel: False

Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.52	(1a)	x	3.1	(2a)	=	172.11	(3a)
Ground floor	83.55	(1b)	x	2.6	(2b)	=	217.23	(3b)
First floor	85.82	(1c)	x	3.28	(2c)	=	281.49	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	224.89	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	670.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.12	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.87	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

SAP WorkSheet: New dwelling design stage

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

0.78	0.76	0.75	0.67	0.65	0.58	0.58	0.56	0.61	0.65	0.68	0.71

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=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(24d)

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

(25)m=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	2	=	4.2			(26)
Windows Type 1			1.5		x1/[1/(4.5)+ 0.04]	=	5.72			(27)
Windows Type 2			5		x1/[1/(1.5)+ 0.04]	=	7.08			(27)
Windows Type 3			1.8		x1/[1/(4.5)+ 0.04]	=	6.86			(27)
Windows Type 4			6.25		x1/[1/(1.5)+ 0.04]	=	8.84			(27)
Rooflights			3.45		x1/[1/(1.5) + 0.04]	=	5.175			(27b)
Floor Type 1			55.52	x	0.17	=	9.4384			(28)
Floor Type 2			28.03	x	0.2	=	5.606			(28)
Walls Type1	76.26	0	76.26	x	0.15	=	11.44			(29)
Walls Type2	80.4	20.75	59.65	x	0.8	=	47.72			(29)
Walls Type3	13.27	0	13.27	x	0.17	=	2.25			(29)
Walls Type4	9.84	0	9.84	x	0.17	=	1.67			(29)
Walls Type5	69.86	0	69.86	x	0.8	=	55.89			(29)
Roof Type1	6	0	6	x	0.15	=	0.9			(30)
Roof Type2	28.23	0	28.23	x	0.15	=	4.23			(30)
Roof Type3	12.9	0	12.9	x	0.15	=	1.94			(30)
Total area of elements, m²			389.46							(31)

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Party wall	24.18	x	0	=	0			(32)
Party wall	43.68	x	0	=	0			(32)
Party wall	67.24	x	0	=	0			(32)

** 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) =	204.05	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		58.42	(36)

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

Total fabric heat loss	(33) + (36) =	262.47	(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	
(38)m=	177.31	174.72	172.19	160.27	158.05	147.67	147.67	145.75	151.67	158.05	162.55	167.27	(38)

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

(39)m=	439.77	437.19	434.65	422.74	420.51	410.14	410.14	408.22	414.14	420.51	425.02	429.73	

Average = Sum(39)$_{1…12}$ /12= 422.73 (39)

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

(40)m=	1.96	1.94	1.93	1.88	1.87	1.82	1.82	1.82	1.84	1.87	1.89	1.91	

Average = Sum(40)$_{1…12}$ /12= 1.88 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.03 (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) + 36 106.26 (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=	116.89	112.64	108.39	104.14	99.89	95.64	95.64	99.89	104.14	108.39	112.64	116.89	

Total = Sum(44)$_{1…12}$ = 1275.17 (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=	173.35	151.61	156.45	136.39	130.87	112.93	104.65	120.09	121.52	141.62	154.59	167.88	

Total = Sum(45)$_{1…12}$ = 1671.95 (45)

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

(46)m=	26	22.74	23.47	20.46	19.63	16.94	15.7	18.01	18.23	21.24	23.19	25.18	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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)

SAP WorkSheet: New dwelling design stage

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.04	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	4.91	(54)
Enter (50) or (54) in (55)		4.91	(55)

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

(56)m=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	348.87	310.15	331.97	306.25	306.4	282.79	280.17	295.61	291.38	317.14	324.45	343.4	(62)

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

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

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

Output from water heater

(64)m=	348.87	310.15	331.97	306.25	306.4	282.79	280.17	295.61	291.38	317.14	324.45	343.4

Output from water heater (annual)$_{1...12}$ — 3738.58 (64)

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

(65)m=	198.06	177.24	192.44	181.24	183.93	173.44	175.21	180.35	176.29	187.51	187.29	196.24	(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=	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	182.06	(66)

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

(67)m=	94.19	83.66	68.04	51.51	38.5	32.51	35.12	45.65	61.28	77.8	90.81	96.81	(67)

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

(68)m=	588.25	594.35	578.97	546.22	504.89	466.03	440.08	433.98	449.36	482.1	523.44	562.29	(68)

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

(69)m=	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	56.24	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	(71)

Water heating gains (Table 5)

(72)m=	266.2	263.75	258.65	251.72	247.22	240.89	235.5	242.4	244.85	252.03	260.12	263.76	(72)

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

(73)m=	1065.57	1058.68	1022.58	966.38	907.54	856.35	827.63	838.96	872.41	928.86	991.3	1039.78	(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	1	x	5	x	10.63	x	0.85	x	0.7	=	56.94	(74)
North	0.9x	0.54	x	1.8	x	10.63	x	0.85	x	0.7	=	11.07	(74)
North	0.9x	1	x	5	x	20.32	x	0.85	x	0.7	=	108.82	(74)
North	0.9x	0.54	x	1.8	x	20.32	x	0.85	x	0.7	=	21.15	(74)
North	0.9x	1	x	5	x	34.53	x	0.85	x	0.7	=	184.91	(74)
North	0.9x	0.54	x	1.8	x	34.53	x	0.85	x	0.7	=	35.95	(74)
North	0.9x	1	x	5	x	55.46	x	0.85	x	0.7	=	297.01	(74)
North	0.9x	0.54	x	1.8	x	55.46	x	0.85	x	0.7	=	57.74	(74)
North	0.9x	1	x	5	x	74.72	x	0.85	x	0.7	=	400.1	(74)
North	0.9x	0.54	x	1.8	x	74.72	x	0.85	x	0.7	=	77.78	(74)
North	0.9x	1	x	5	x	79.99	x	0.85	x	0.7	=	428.32	(74)
North	0.9x	0.54	x	1.8	x	79.99	x	0.85	x	0.7	=	83.27	(74)
North	0.9x	1	x	5	x	74.68	x	0.85	x	0.7	=	399.89	(74)
North	0.9x	0.54	x	1.8	x	74.68	x	0.85	x	0.7	=	77.74	(74)
North	0.9x	1	x	5	x	59.25	x	0.85	x	0.7	=	317.26	(74)
North	0.9x	0.54	x	1.8	x	59.25	x	0.85	x	0.7	=	61.68	(74)
North	0.9x	1	x	5	x	41.52	x	0.85	x	0.7	=	222.32	(74)
North	0.9x	0.54	x	1.8	x	41.52	x	0.85	x	0.7	=	43.22	(74)
North	0.9x	1	x	5	x	24.19	x	0.85	x	0.7	=	129.53	(74)
North	0.9x	0.54	x	1.8	x	24.19	x	0.85	x	0.7	=	25.18	(74)
North	0.9x	1	x	5	x	13.12	x	0.85	x	0.7	=	70.25	(74)
North	0.9x	0.54	x	1.8	x	13.12	x	0.85	x	0.7	=	13.66	(74)
North	0.9x	1	x	5	x	8.86	x	0.85	x	0.7	=	47.47	(74)
North	0.9x	0.54	x	1.8	x	8.86	x	0.85	x	0.7	=	9.23	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	33.8	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	55.35	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	70.51	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	79.69	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	83.04	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	79.92	(78)

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SAP WorkSheet: New dwelling design stage

South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	78.08	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	75.83	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	73.66	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	59.7	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	40.06	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	29.2	(78)
West	0.9x	1	x	6.25	x	19.64	x	0.85	x	0.7	=	65.73	(80)
West	0.9x	1	x	6.25	x	38.42	x	0.85	x	0.7	=	128.59	(80)
West	0.9x	1	x	6.25	x	63.27	x	0.85	x	0.7	=	211.77	(80)
West	0.9x	1	x	6.25	x	92.28	x	0.85	x	0.7	=	308.85	(80)
West	0.9x	1	x	6.25	x	113.09	x	0.85	x	0.7	=	378.51	(80)
West	0.9x	1	x	6.25	x	115.77	x	0.85	x	0.7	=	387.47	(80)
West	0.9x	1	x	6.25	x	110.22	x	0.85	x	0.7	=	368.89	(80)
West	0.9x	1	x	6.25	x	94.68	x	0.85	x	0.7	=	316.87	(80)
West	0.9x	1	x	6.25	x	73.59	x	0.85	x	0.7	=	246.29	(80)
West	0.9x	1	x	6.25	x	45.59	x	0.85	x	0.7	=	152.58	(80)
West	0.9x	1	x	6.25	x	24.49	x	0.85	x	0.7	=	81.96	(80)
West	0.9x	1	x	6.25	x	16.15	x	0.85	x	0.7	=	54.06	(80)
Rooflights	0.9x	1	x	3.45	x	26	x	0.65	x	0.7	=	36.73	(82)
Rooflights	0.9x	1	x	3.45	x	54	x	0.65	x	0.7	=	76.29	(82)
Rooflights	0.9x	1	x	3.45	x	96	x	0.65	x	0.7	=	135.63	(82)
Rooflights	0.9x	1	x	3.45	x	150	x	0.65	x	0.7	=	211.92	(82)
Rooflights	0.9x	1	x	3.45	x	192	x	0.65	x	0.7	=	271.25	(82)
Rooflights	0.9x	1	x	3.45	x	200	x	0.65	x	0.7	=	282.55	(82)
Rooflights	0.9x	1	x	3.45	x	189	x	0.65	x	0.7	=	267.01	(82)
Rooflights	0.9x	1	x	3.45	x	157	x	0.65	x	0.7	=	221.81	(82)
Rooflights	0.9x	1	x	3.45	x	115	x	0.65	x	0.7	=	162.47	(82)
Rooflights	0.9x	1	x	3.45	x	66	x	0.65	x	0.7	=	93.24	(82)
Rooflights	0.9x	1	x	3.45	x	33	x	0.65	x	0.7	=	46.62	(82)
Rooflights	0.9x	1	x	3.45	x	21	x	0.65	x	0.7	=	29.67	(82)

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

(83)m=	204.28	390.2	638.76	955.21	1210.69	1261.53	1191.62	993.44	747.96	460.24	252.55	169.63	(83)

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

(84)m=	1269.84	1448.89	1661.34	1921.59	2118.22	2117.88	2019.25	1832.4	1620.37	1389.1	1243.85	1209.41	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.85	0.73	0.79	0.94	0.99	1	1	(86)

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

(87)m=	18.79	18.96	19.3	19.81	20.29	20.7	20.88	20.84	20.5	19.89	19.28	18.79	(87)

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

(88)m=	19.36	19.37	19.38	19.41	19.42	19.45	19.45	19.46	19.44	19.42	19.41	19.39	(88)

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

(89)m=	1	0.99	0.99	0.97	0.91	0.75	0.54	0.61	0.88	0.98	0.99	1	(89)

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

(90)m=	16.5	16.76	17.26	18.02	18.71	19.24	19.41	19.39	19.02	18.15	17.25	16.53	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	16.93	17.17	17.64	18.35	19	19.51	19.69	19.66	19.29	18.48	17.63	16.96	(92)

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

(93)m=	16.93	17.17	17.64	18.35	19	19.51	19.69	19.66	19.29	18.48	17.63	16.96	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.76	0.58	0.64	0.87	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1263.03	1436.2	1632.21	1839.42	1895.1	1609.09	1162.62	1178.7	1415.56	1348.93	1232.98	1204.06	(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=	5554.67	5364.52	4842.6	3996.16	3070.36	2014.54	1265.3	1331.64	2150.51	3311.89	4476.82	5481.61	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3192.98	2639.83	2388.53	1552.85	874.39	0	0	0	0	1460.44	2335.57	3182.5	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 17627.09 (98)

Space heating requirement in kWh/m²/year 78.38 (99)

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8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	3855.31	3035.03	3102.46	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.53	0.62	0.57	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2056	1879.84	1756.23	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2195.83	2094.34	1901.23	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(104)$_{6..8}$ = 0 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.62 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6..8}$ = 0 (106)

SAP WorkSheet: New dwelling design stage

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(107) = 0 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0 (108)

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		17627.09	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	18508.44	(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		3738.58	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	3925.51	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	224.34	(313)
Cooling System Energy Efficiency Ratio		4.38	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		665.36	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a) x	4.24	x 0.01 =	784.76	(340a)
Water heating from CHP	(310a) x	4.24	x 0.01 =	166.44	(342a)
		Fuel Price			
Pumps and fans	(331)	13.19	x 0.01 =	0	(349)

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SAP WorkSheet: New dwelling design stage

Energy for lighting	(332)	13.19	x 0.01 =	87.76	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			1158.96	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.8	(357)
SAP rating (section12)		74.84	(358)

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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	5324.98	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	116.43	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	5441.42	(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) =				5441.42	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	345.32	(379)
Total CO2, kg/year	sum of (376)…(382) =				5786.74	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				25.73	(384)
EI rating (section 14)					71.27	(385)

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13b. Primary Energy – Community heating scheme

		Energy kWh/year	Primary factor		P.Energy kWh/year	
Energy 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				91	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	30076.29	(367)
Electrical energy for heat distribution	[(313) x			=	688.72	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	30765.01	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					30765.01	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				30765.01	(376)
Energy associated with space cooling	(315) x		3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	0	(378)

Energy associated with electricity for lighting	(332))) x	3.07	=	2042.66	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =			32807.68	(383)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.52	(1a)	x	3.1	(2a)	=	172.11	(3a)
Ground floor	83.55	(1b)	x	2.6	(2b)	=	217.23	(3b)
First floor	85.82	(1c)	x	3.28	(2c)	=	281.49	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	224.89	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	670.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.12	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.87	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	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

0.78	0.76	0.75	0.67	0.65	0.58	0.58	0.56	0.61	0.65	0.68	0.71

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=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(24d)

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

(25)m=	0.8	0.79	0.78	0.72	0.71	0.67	0.67	0.66	0.69	0.71	0.73	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	2	=	4.2			(26)
Windows Type 1			1.5	x1/[1/(4.5)+ 0.04]		=	5.72			(27)
Windows Type 2			5	x1/[1/(1.5)+ 0.04]		=	7.08			(27)
Windows Type 3			1.8	x1/[1/(4.5)+ 0.04]		=	6.86			(27)
Windows Type 4			6.25	x1/[1/(1.5)+ 0.04]		=	8.84			(27)
Rooflights			3.45	x1/[1/(1.5) + 0.04]		=	5.175			(27b)
Floor Type 1			55.52	x	0.17	=	9.4384			(28)
Floor Type 2			28.03	x	0.2	=	5.606			(28)
Walls Type1	76.26	0	76.26	x	0.15	=	11.44			(29)
Walls Type2	80.4	20.75	59.65	x	0.8	=	47.72			(29)
Walls Type3	13.27	0	13.27	x	0.17	=	2.25			(29)
Walls Type4	9.84	0	9.84	x	0.17	=	1.67			(29)
Walls Type5	69.86	0	69.86	x	0.8	=	55.89			(29)
Roof Type1	6	0	6	x	0.15	=	0.9			(30)
Roof Type2	28.23	0	28.23	x	0.15	=	4.23			(30)
Roof Type3	12.9	0	12.9	x	0.15	=	1.94			(30)
Total area of elements, m²			389.46							(31)

DER WorkSheet: New dwelling design stage

Party wall	24.18	x	0	=	0				(32)
Party wall	43.68	x	0	=	0				(32)
Party wall	67.24	x	0	=	0				(32)

** 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) =	204.05	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		58.42	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	262.47	(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	
(38)m=	177.31	174.72	172.19	160.27	158.05	147.67	147.67	145.75	151.67	158.05	162.55	167.27	(38)

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

(39)m=	439.77	437.19	434.65	422.74	420.51	410.14	410.14	408.22	414.14	420.51	425.02	429.73	

Average = Sum(39)$_{1…12}$ /12= 422.73 (39)

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

(40)m=	1.96	1.94	1.93	1.88	1.87	1.82	1.82	1.82	1.84	1.87	1.89	1.91	

Average = Sum(40)$_{1…12}$ /12= 1.88 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.03 (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) + 36 106.26 (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=	116.89	112.64	108.39	104.14	99.89	95.64	95.64	99.89	104.14	108.39	112.64	116.89

Total = Sum(44)$_{1…12}$ = 1275.17 (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=	173.35	151.61	156.45	136.39	130.87	112.93	104.65	120.09	121.52	141.62	154.59	167.88

Total = Sum(45)$_{1…12}$ = 1671.95 (45)

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

(46)m=	26	22.74	23.47	20.46	19.63	16.94	15.7	18.01	18.23	21.24	23.19	25.18	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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)

DER WorkSheet: New dwelling design stage

DRAFT

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.04	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	4.91	(54)
Enter (50) or (54) in (55)		4.91	(55)

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

(56)m=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	348.87	310.15	331.97	306.25	306.4	282.79	280.17	295.61	291.38	317.14	324.45	343.4	(62)

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

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

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

Output from water heater

(64)m=	348.87	310.15	331.97	306.25	306.4	282.79	280.17	295.61	291.38	317.14	324.45	343.4

Output from water heater (annual)$_{1...12}$ — 3738.58 (64)

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

(65)m=	198.06	177.24	192.44	181.24	183.93	173.44	175.21	180.35	176.29	187.51	187.29	196.24	(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=	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	151.71	(66)

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

(67)m=	38.69	34.36	27.95	21.16	15.82	13.35	14.43	18.75	25.17	31.96	37.3	39.77	(67)

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

(68)m=	394.13	398.22	387.91	365.97	338.27	312.24	294.85	290.76	301.07	323.01	350.71	376.74	(68)

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

(69)m=	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	(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=	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	-121.37	(71)

Water heating gains (Table 5)

(72)m=	266.2	263.75	258.65	251.72	247.22	240.89	235.5	242.4	244.85	252.03	260.12	263.76	(72)

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

(73)m=	767.53	764.84	743.02	707.36	669.83	635	613.3	620.43	639.61	675.51	716.65	748.78	(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	5	x	10.63	x	0.85	x	0.7	=	43.85	(74)
North	0.9x	0.54	x	1.8	x	10.63	x	0.85	x	0.7	=	11.07	(74)
North	0.9x	0.77	x	5	x	20.32	x	0.85	x	0.7	=	83.79	(74)
North	0.9x	0.54	x	1.8	x	20.32	x	0.85	x	0.7	=	21.15	(74)
North	0.9x	0.77	x	5	x	34.53	x	0.85	x	0.7	=	142.38	(74)
North	0.9x	0.54	x	1.8	x	34.53	x	0.85	x	0.7	=	35.95	(74)
North	0.9x	0.77	x	5	x	55.46	x	0.85	x	0.7	=	228.7	(74)
North	0.9x	0.54	x	1.8	x	55.46	x	0.85	x	0.7	=	57.74	(74)
North	0.9x	0.77	x	5	x	74.72	x	0.85	x	0.7	=	308.08	(74)
North	0.9x	0.54	x	1.8	x	74.72	x	0.85	x	0.7	=	77.78	(74)
North	0.9x	0.77	x	5	x	79.99	x	0.85	x	0.7	=	329.81	(74)
North	0.9x	0.54	x	1.8	x	79.99	x	0.85	x	0.7	=	83.27	(74)
North	0.9x	0.77	x	5	x	74.68	x	0.85	x	0.7	=	307.92	(74)
North	0.9x	0.54	x	1.8	x	74.68	x	0.85	x	0.7	=	77.74	(74)
North	0.9x	0.77	x	5	x	59.25	x	0.85	x	0.7	=	244.29	(74)
North	0.9x	0.54	x	1.8	x	59.25	x	0.85	x	0.7	=	61.68	(74)
North	0.9x	0.77	x	5	x	41.52	x	0.85	x	0.7	=	171.19	(74)
North	0.9x	0.54	x	1.8	x	41.52	x	0.85	x	0.7	=	43.22	(74)
North	0.9x	0.77	x	5	x	24.19	x	0.85	x	0.7	=	99.74	(74)
North	0.9x	0.54	x	1.8	x	24.19	x	0.85	x	0.7	=	25.18	(74)
North	0.9x	0.77	x	5	x	13.12	x	0.85	x	0.7	=	54.09	(74)
North	0.9x	0.54	x	1.8	x	13.12	x	0.85	x	0.7	=	13.66	(74)
North	0.9x	0.77	x	5	x	8.86	x	0.85	x	0.7	=	36.55	(74)
North	0.9x	0.54	x	1.8	x	8.86	x	0.85	x	0.7	=	9.23	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	33.8	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	55.35	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	70.51	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	79.69	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	83.04	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	79.92	(78)

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DER WorkSheet: New dwelling design stage

South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	78.08	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	75.83	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	73.66	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	59.7	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	40.06	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	29.2	(78)
West	0.9x	0.77	x	6.25	x	19.64	x	0.85	x	0.7	=	50.61	(80)
West	0.9x	0.77	x	6.25	x	38.42	x	0.85	x	0.7	=	99.01	(80)
West	0.9x	0.77	x	6.25	x	63.27	x	0.85	x	0.7	=	163.06	(80)
West	0.9x	0.77	x	6.25	x	92.28	x	0.85	x	0.7	=	237.81	(80)
West	0.9x	0.77	x	6.25	x	113.09	x	0.85	x	0.7	=	291.45	(80)
West	0.9x	0.77	x	6.25	x	115.77	x	0.85	x	0.7	=	298.35	(80)
West	0.9x	0.77	x	6.25	x	110.22	x	0.85	x	0.7	=	284.04	(80)
West	0.9x	0.77	x	6.25	x	94.68	x	0.85	x	0.7	=	243.99	(80)
West	0.9x	0.77	x	6.25	x	73.59	x	0.85	x	0.7	=	189.65	(80)
West	0.9x	0.77	x	6.25	x	45.59	x	0.85	x	0.7	=	117.49	(80)
West	0.9x	0.77	x	6.25	x	24.49	x	0.85	x	0.7	=	63.11	(80)
West	0.9x	0.77	x	6.25	x	16.15	x	0.85	x	0.7	=	41.62	(80)
Rooflights	0.9x	1	x	3.45	x	26	x	0.65	x	0.7	=	36.73	(82)
Rooflights	0.9x	1	x	3.45	x	54	x	0.65	x	0.7	=	76.29	(82)
Rooflights	0.9x	1	x	3.45	x	96	x	0.65	x	0.7	=	135.63	(82)
Rooflights	0.9x	1	x	3.45	x	150	x	0.65	x	0.7	=	211.92	(82)
Rooflights	0.9x	1	x	3.45	x	192	x	0.65	x	0.7	=	271.25	(82)
Rooflights	0.9x	1	x	3.45	x	200	x	0.65	x	0.7	=	282.55	(82)
Rooflights	0.9x	1	x	3.45	x	189	x	0.65	x	0.7	=	267.01	(82)
Rooflights	0.9x	1	x	3.45	x	157	x	0.65	x	0.7	=	221.81	(82)
Rooflights	0.9x	1	x	3.45	x	115	x	0.65	x	0.7	=	162.47	(82)
Rooflights	0.9x	1	x	3.45	x	66	x	0.65	x	0.7	=	93.24	(82)
Rooflights	0.9x	1	x	3.45	x	33	x	0.65	x	0.7	=	46.62	(82)
Rooflights	0.9x	1	x	3.45	x	21	x	0.65	x	0.7	=	29.67	(82)

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

(83)m=	176.06	335.6	547.52	815.86	1031.61	1073.9	1014.8	847.59	640.18	395.36	217.54	146.28	(83)

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

(84)m=	943.59	1100.44	1290.55	1523.22	1701.43	1708.89	1628.1	1468.03	1279.79	1070.87	934.19	895.05	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.91	0.82	0.86	0.97	0.99	1	1	(86)

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

(87)m=	18.67	18.83	19.17	19.67	20.16	20.6	20.82	20.77	20.4	19.78	19.17	18.68	(87)

DER WorkSheet: New dwelling design stage

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

(88)m=	19.36	19.37	19.38	19.41	19.42	19.45	19.45	19.46	19.44	19.42	19.41	19.39	(88)

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

(89)m=	1	1	0.99	0.98	0.95	0.83	0.64	0.71	0.93	0.99	1	1	(89)

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

(90)m=	16.33	16.58	17.07	17.82	18.54	19.15	19.38	19.35	18.89	17.99	17.09	16.37	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	16.77	17	17.46	18.17	18.84	19.42	19.65	19.62	19.17	18.32	17.48	16.8	(92)

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

(93)m=	16.77	17	17.46	18.17	18.84	19.42	19.65	19.62	19.17	18.32	17.48	16.8	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.83	0.67	0.73	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	941.51	1096.13	1279.35	1487.37	1590.31	1422.66	1087.62	1078.47	1181.53	1055.58	930.7	893.47	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5483.26	5289.03	4763.99	3918.11	3002.61	1976.06	1251.25	1312.46	2099.6	3247.62	4411.05	5413.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3379.07	2817.63	2592.57	1750.14	1050.75	0	0	0	0	1630.87	2505.85	3363.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 19090 (98)

Space heating requirement in kWh/m²/year 84.89 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	3855.31	3035.03	3102.46	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.52	0.6	0.55	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1993.02	1829.03	1710.14	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2115.13	2018.41	1839.05	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 0 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.62 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	0	0	0	0	0	0

	Total = Sum(107) =	0	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0	(108)

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		19090	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	20044.5	(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		3738.58	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	3925.51	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	239.7	(313)
Cooling System Energy Efficiency Ratio		4.38	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		683.29	(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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	5689.59	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	124.4	(372)

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DER WorkSheet: New dwelling design stage

Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	5813.99	(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) =			5813.99	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	354.63	(379)
Total CO2, kg/year	sum of (376)…(382) =			6168.62	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			27.43	(384)
EI rating (section 14)				69.37	(385)

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SAP Input

Property Details: Flat 1

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2015

Floor Location:	Floor area:	Storey height:
Basement floor	55.75 m²	3.1 m
Floor 1	156.34 m²	2.6 m
Floor 2	156.01 m²	3.28 m

Living area:	52.13 m² (fraction 0.142)
Front of dwelling faces:	Unspecified

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
D2	Manufacturer	Half glazed	low-E, En = 0.2, hard coat	No	Metal
W1	SAP 2012	Windows	Single-glazed	No	
W2	SAP 2012	Windows	Single-glazed	No	Wood
W3	SAP 2012	Windows	Single-glazed	No	Wood
W4	SAP 2012	Windows	Single-glazed	No	Wood
W5	SAP 2012	Windows	Single-glazed	No	Wood
W6	SAP 2012	Windows	Single-glazed	No	Wood
W7	SAP 2012	Windows	Single-glazed	No	Wood
W8	SAP 2012	Windows	low-E, En = 0.2, hard coat	No	Wood
W09	SAP 2012	Windows	Single-glazed	No	Wood
w10	SAP 2012	Windows	Single-glazed	No	Wood
w11	SAP 2012	Windows	Single-glazed	No	Wood
w12	SAP 2012	Windows	Single-glazed	No	Wood
w13	SAP 2012	Windows	Single-glazed	No	Wood

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
D2	16mm or more mm	0.8	0.65	2	1.64	1
W1		0.7	0.85	4.5	1.5	2
W2		0.7	0.85	4.5	1.64	1
W3		0.7	0.85	4.5	1.64	1
W4		0.7	0.85	4.5	1.64	1
W5		0.7	0.85	4.5	1.64	1
W6		0.7	0.85	4.5	0.83	1
W7		0.7	0.85	4.5	1.64	1
W8	16mm or more	0.7	0.72	2.1	3.1	3

SAP Input

W09	0.7	0.85	4.8	5.13	1
w10	0.7	0.85	4.5	2.4	1
w11	0.7	0.85	4.5	2.4	1
w12	0.7	0.85	4.5	2.4	1
w13	0.7	0.85	4.5	2.83	3

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
D2		External wall GF	West	0.78	2.1
W1		External wall GF	South	1	1.5
W2		External wall GF	West	1.09	1.5
W3		External wall GF	South West	1.09	1.5
W4		External wall GF	West	1.09	1.5
W5		External wall GF	North West	1.09	1.5
W6		External wall GF	West	0.753	1.1
W7		External wall GF	South West	1.09	1.5
W8		External wall GF	North	1.24	2.5
W09		External FF	South	2.33	2.2
w10		External FF	South West	1.09	2.2
w11		External FF	West	1.09	2.2
w12		External FF	North West	1.09	2.2
w13		External FF	North	1.09	2.6

Overshading: More than average

Opaque Elements:

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Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Basement wall	87.11	0	87.11	0.15	0	False	N/A
External wall GF	101.74	22.97	78.77	0.8	0	False	N/A
corridor GF	43.34	0	43.34	0.2	0.9	False	N/A
Coprridor FF	53.64	0	53.64	0.2	0.9	False	N/A
External FF	119.93	20.82	99.11	0.8	0	False	N/A
internal	23.62	0	23.62	0.15	0		N/A
Basement floor	55.75			0.17			N/A
ground floor	100.58			0.2			N/A
internal floor	24.67			0.2			N/A
Internal Elements							
Party Elements							
party wall Basement	30.03						N/A
Party wall FF	25.87						N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: No (Assumed)
Ventilation: Natural ventilation (extract fans)
Number of chimneys: 2 (main: 0, secondary: 1, other: 1)
Number of open flues: 0
Number of fans: 6
Number of passive stacks: 0
Number of sides sheltered: 4
Pressure test: 15

Main heating system:

Main heating system: Community heating schemes
Heat source: Community boilers

	heat from boilers – mains gas, heat fraction 1, efficiency 91 Piping>=1991, pre-insulated, low temp, variable flow
Main heating Control:	
Main heating Control:	Charging system linked to use of community heating, programmer and at least two room thermosta Control code: 2312
Secondary heating system:	
Secondary heating system:	Room heaters Solid fuel room heaters Fuel :wood pellets (bulk supply in bags, for main heating) Info Source: SAP Tables Closed room heater HETAS Approved
Space cooling system:	
Space cooling system:	Split/multiple systems Tested data to EN 14511: Brand/Model: TBC EER: 3.5 Compressor control: Systems with On/Off control Cooled area: 140 (fraction 0.380)
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :heat from boilers – mains gas Hot water cylinder Cylinder volume: 310 litres Cylinder insulation: Jacket 35 mm Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: Flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.75	(1a)	x	3.1	(2a)	=	172.82	(3a)
Ground floor	156.34	(1b)	x	2.6	(2b)	=	406.48	(3b)
First floor	156.01	(1c)	x	3.28	(2c)	=	511.71	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	368.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1091.02	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	1	=	2	x 40 =	80	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							6	x 10 =	60	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	140	÷ (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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

SAP WorkSheet: New dwelling design stage

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

0.78	0.77	0.75	0.68	0.66	0.58	0.58	0.57	0.61	0.66	0.69	0.72

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(24d)

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

(25)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x	2	=	4.2			(26)
Doors Type 2			1.64	x	2	=	3.28			(26)
Windows Type 1			1.5		x1/[1/(4.5)+ 0.04]	=	5.72			(27)
Windows Type 2			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 3			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 4			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 5			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 6			0.83		x1/[1/(4.5)+ 0.04]	=	3.17			(27)
Windows Type 7			1.64		x1/[1/(4.5)+ 0.04]	=	6.25			(27)
Windows Type 8			3.1		x1/[1/(2.1)+ 0.04]	=	6.01			(27)
Windows Type 9			5.13		x1/[1/(4.8)+ 0.04]	=	20.66			(27)
Windows Type 10			2.4		x1/[1/(4.5)+ 0.04]	=	9.15			(27)
Windows Type 11			2.4		x1/[1/(4.5)+ 0.04]	=	9.15			(27)
Windows Type 12			2.4		x1/[1/(4.5)+ 0.04]	=	9.15			(27)
Windows Type 13			2.83		x1/[1/(4.5)+ 0.04]	=	10.79			(27)
Floor Type 1			55.75	x	0.17	=	9.4775			(28)
Floor Type 2			100.58	x	0.2	=	20.116			(28)

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SAP WorkSheet: New dwelling design stage

Floor Type 3			24.67	x	0.2	=	4.934			(28)
Walls Type1	87.11	0	87.11	x	0.15	=	13.07			(29)
Walls Type2	101.74	22.97	78.77	x	0.8	=	63.02			(29)
Walls Type3	43.34	0	43.34	x	0.17	=	7.35			(29)
Walls Type4	53.64	0	53.64	x	0.17	=	9.09			(29)
Walls Type5	119.93	20.82	99.11	x	0.8	=	79.29			(29)
Roof	23.62	0	23.62	x	0.15	=	3.54			(30)
Total area of elements, m²			612.48							(31)
Party wall			30.03	x	0	=	0			(32)
Party wall			25.87	x	0	=	0			(32)

** 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) = 361.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 91.87 (36)

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

Total fabric heat loss (33) + (36) = 453.62 (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=	290.64	286.34	282.13	262.36	258.66	241.43	241.43	238.24	248.07	258.66	266.14	273.97	(38)

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

(39)m=	744.26	739.96	735.75	715.97	712.27	695.05	695.05	691.86	701.68	712.27	719.76	727.58	

Average = Sum(39)$_{1…12}$ /12= 715.96 (39)

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

(40)m=	2.02	2.01	2	1.95	1.94	1.89	1.89	1.88	1.91	1.94	1.96	1.98

Average = Sum(40)$_{1…12}$ /12= 1.95 (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 3.22 (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) + 36 110.69 (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
(44)m=	121.75	117.33	112.9	108.47	104.04	99.62	99.62	104.04	108.47	112.9	117.33	121.75

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

Total = Sum(44)$_{1…12}$ = 1328.23 (44)

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SAP WorkSheet: New dwelling design stage

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=	180.56	157.92	162.96	142.07	136.32	117.63	109	125.08	126.58	147.51	161.02	174.86

Total = Sum(45)$_{1...12}$ = 1741.52 (45)

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

(46)m=	27.08	23.69	24.44	21.31	20.45	17.64	16.35	18.76	18.99	22.13	24.15	26.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 310 (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) = 310 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.04 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.73 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 5.67 (54)

Enter (50) or (54) in (55) 5.67 (55)

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

(56)m=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	379.56	337.66	361.96	334.65	335.32	310.21	308	324.08	319.16	346.52	353.6	373.86	(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=	379.56	337.66	361.96	334.65	335.32	310.21	308	324.08	319.16	346.52	353.6	373.86

Output from water heater (annual)$_{1...12}$ 4084.59 (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=	219.24	196.3	213.38	201.3	204.53	193.18	195.44	200.79	196.15	208.25	207.61	217.34	(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

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SAP WorkSheet: New dwelling design stage

(66)m=	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	193.23	(66)

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

(67)m=	128.45	114.09	92.78	70.24	52.51	44.33	47.9	62.26	83.57	106.11	123.84	132.02	(67)

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

(68)m=	763.18	771.1	751.15	708.66	655.03	604.63	570.95	563.03	582.99	625.47	679.11	729.51	(68)

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

(69)m=	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	57.54	(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=	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	(71)

Water heating gains (Table 5)

(72)m=	294.67	292.12	286.81	279.59	274.9	268.3	262.69	269.88	272.43	279.9	288.34	292.13	(72)

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

(73)m=	1308.26	1299.26	1252.69	1180.44	1104.39	1039.21	1003.5	1017.13	1060.94	1133.44	1213.24	1275.61	(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	0.54	x	3.1	x	10.63	x	0.72	x	0.7	=	24.22	(74)
North	0.9x	0.54	x	2.83	x	10.63	x	0.85	x	0.7	=	26.11	(74)
North	0.9x	0.54	x	3.1	x	20.32	x	0.72	x	0.7	=	46.29	(74)
North	0.9x	0.54	x	2.83	x	20.32	x	0.85	x	0.7	=	49.89	(74)
North	0.9x	0.54	x	3.1	x	34.53	x	0.72	x	0.7	=	78.66	(74)
North	0.9x	0.54	x	2.83	x	34.53	x	0.85	x	0.7	=	84.77	(74)
North	0.9x	0.54	x	3.1	x	55.46	x	0.72	x	0.7	=	126.35	(74)
North	0.9x	0.54	x	2.83	x	55.46	x	0.85	x	0.7	=	136.17	(74)
North	0.9x	0.54	x	3.1	x	74.72	x	0.72	x	0.7	=	170.2	(74)
North	0.9x	0.54	x	2.83	x	74.72	x	0.85	x	0.7	=	183.43	(74)
North	0.9x	0.54	x	3.1	x	79.99	x	0.72	x	0.7	=	182.2	(74)
North	0.9x	0.54	x	2.83	x	79.99	x	0.85	x	0.7	=	196.37	(74)
North	0.9x	0.54	x	3.1	x	74.68	x	0.72	x	0.7	=	170.11	(74)
North	0.9x	0.54	x	2.83	x	74.68	x	0.85	x	0.7	=	183.33	(74)
North	0.9x	0.54	x	3.1	x	59.25	x	0.72	x	0.7	=	134.96	(74)
North	0.9x	0.54	x	2.83	x	59.25	x	0.85	x	0.7	=	145.45	(74)
North	0.9x	0.54	x	3.1	x	41.52	x	0.72	x	0.7	=	94.57	(74)
North	0.9x	0.54	x	2.83	x	41.52	x	0.85	x	0.7	=	101.93	(74)
North	0.9x	0.54	x	3.1	x	24.19	x	0.72	x	0.7	=	55.1	(74)
North	0.9x	0.54	x	2.83	x	24.19	x	0.85	x	0.7	=	59.39	(74)
North	0.9x	0.54	x	3.1	x	13.12	x	0.72	x	0.7	=	29.88	(74)

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SAP WorkSheet: New dwelling design stage

North	0.9x	0.54	x	2.83	x	13.12	x	0.85	x	0.7	=	32.2	(74)
North	0.9x	0.54	x	3.1	x	8.86	x	0.72	x	0.7	=	20.19	(74)
North	0.9x	0.54	x	2.83	x	8.86	x	0.85	x	0.7	=	21.76	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	22.53	(78)
South	0.9x	1	x	5.13	x	46.75	x	0.85	x	0.7	=	128.43	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	36.9	(78)
South	0.9x	1	x	5.13	x	76.57	x	0.85	x	0.7	=	210.34	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	47.01	(78)
South	0.9x	1	x	5.13	x	97.53	x	0.85	x	0.7	=	267.94	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	53.13	(78)
South	0.9x	1	x	5.13	x	110.23	x	0.85	x	0.7	=	302.83	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	55.36	(78)
South	0.9x	1	x	5.13	x	114.87	x	0.85	x	0.7	=	315.56	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	53.28	(78)
South	0.9x	1	x	5.13	x	110.55	x	0.85	x	0.7	=	303.69	(78)
South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	52.06	(78)
South	0.9x	1	x	5.13	x	108.01	x	0.85	x	0.7	=	296.72	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	50.55	(78)
South	0.9x	1	x	5.13	x	104.89	x	0.85	x	0.7	=	288.16	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	49.1	(78)
South	0.9x	1	x	5.13	x	101.89	x	0.85	x	0.7	=	279.89	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	39.8	(78)
South	0.9x	1	x	5.13	x	82.59	x	0.85	x	0.7	=	226.87	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	26.71	(78)
South	0.9x	1	x	5.13	x	55.42	x	0.85	x	0.7	=	152.24	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	19.47	(78)
South	0.9x	1	x	5.13	x	40.4	x	0.85	x	0.7	=	110.98	(78)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	2.4	x	36.79		0.85	x	0.7	=	25.54	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	2.4	x	62.67		0.85	x	0.7	=	43.5	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	2.4	x	85.75		0.85	x	0.7	=	59.51	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	2.4	x	106.25		0.85	x	0.7	=	73.74	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)

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SAP WorkSheet: New dwelling design stage

Southwest	0.9x	0.54	x	2.4	x	119.01		0.85	x	0.7	=	82.59	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	2.4	x	118.15		0.85	x	0.7	=	82	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	2.4	x	113.91		0.85	x	0.7	=	79.05	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	2.4	x	104.39		0.85	x	0.7	=	72.45	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	2.4	x	92.85		0.85	x	0.7	=	64.44	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	2.4	x	69.27		0.85	x	0.7	=	48.07	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	2.4	x	44.07		0.85	x	0.7	=	30.59	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	2.4	x	31.49		0.85	x	0.7	=	21.85	(79)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	0.83	x	19.64	x	0.85	x	0.7	=	4.71	(80)
West	0.9x	0.54	x	2.4	x	19.64	x	0.85	x	0.7	=	13.63	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	0.83	x	38.42	x	0.85	x	0.7	=	9.22	(80)
West	0.9x	0.54	x	2.4	x	38.42	x	0.85	x	0.7	=	26.66	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	0.83	x	63.27	x	0.85	x	0.7	=	15.19	(80)
West	0.9x	0.54	x	2.4	x	63.27	x	0.85	x	0.7	=	43.91	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	0.83	x	92.28	x	0.85	x	0.7	=	22.15	(80)
West	0.9x	0.54	x	2.4	x	92.28	x	0.85	x	0.7	=	64.04	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	0.83	x	113.09	x	0.85	x	0.7	=	27.14	(80)

DRAFT

SAP WorkSheet: New dwelling design stage

West	0.9x	0.54	x	2.4	x	113.09	x	0.85	x	0.7	=	78.49	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	0.83	x	115.77	x	0.85	x	0.7	=	27.79	(80)
West	0.9x	0.54	x	2.4	x	115.77	x	0.85	x	0.7	=	80.35	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	0.83	x	110.22	x	0.85	x	0.7	=	26.45	(80)
West	0.9x	0.54	x	2.4	x	110.22	x	0.85	x	0.7	=	76.49	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	0.83	x	94.68	x	0.85	x	0.7	=	22.72	(80)
West	0.9x	0.54	x	2.4	x	94.68	x	0.85	x	0.7	=	65.71	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	0.83	x	73.59	x	0.85	x	0.7	=	17.66	(80)
West	0.9x	0.54	x	2.4	x	73.59	x	0.85	x	0.7	=	51.07	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	0.83	x	45.59	x	0.85	x	0.7	=	10.94	(80)
West	0.9x	0.54	x	2.4	x	45.59	x	0.85	x	0.7	=	31.64	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	0.83	x	24.49	x	0.85	x	0.7	=	5.88	(80)
West	0.9x	0.54	x	2.4	x	24.49	x	0.85	x	0.7	=	17	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	0.83	x	16.15	x	0.85	x	0.7	=	3.88	(80)
West	0.9x	0.54	x	2.4	x	16.15	x	0.85	x	0.7	=	11.21	(80)
Northwest	0.9x	0.54	x	1.64	x	11.28	x	0.85	x	0.7	=	5.35	(81)
Northwest	0.9x	0.54	x	2.4	x	11.28	x	0.85	x	0.7	=	7.83	(81)
Northwest	0.9x	0.54	x	1.64	x	22.97	x	0.85	x	0.7	=	10.89	(81)
Northwest	0.9x	0.54	x	2.4	x	22.97	x	0.85	x	0.7	=	15.94	(81)
Northwest	0.9x	0.54	x	1.64	x	41.38	x	0.85	x	0.7	=	19.62	(81)
Northwest	0.9x	0.54	x	2.4	x	41.38	x	0.85	x	0.7	=	28.72	(81)
Northwest	0.9x	0.54	x	1.64	x	67.96	x	0.85	x	0.7	=	32.23	(81)
Northwest	0.9x	0.54	x	2.4	x	67.96	x	0.85	x	0.7	=	47.16	(81)
Northwest	0.9x	0.54	x	1.64	x	91.35	x	0.85	x	0.7	=	43.32	(81)
Northwest	0.9x	0.54	x	2.4	x	91.35	x	0.85	x	0.7	=	63.39	(81)
Northwest	0.9x	0.54	x	1.64	x	97.38	x	0.85	x	0.7	=	46.18	(81)
Northwest	0.9x	0.54	x	2.4	x	97.38	x	0.85	x	0.7	=	67.59	(81)

DRAFT

SAP WorkSheet: New dwelling design stage

Northwest	0.9x	0.54	x	1.64	x	91.1	x	0.85	x	0.7	=	43.2	(81)
Northwest	0.9x	0.54	x	2.4	x	91.1	x	0.85	x	0.7	=	63.22	(81)
Northwest	0.9x	0.54	x	1.64	x	72.63	x	0.85	x	0.7	=	34.44	(81)
Northwest	0.9x	0.54	x	2.4	x	72.63	x	0.85	x	0.7	=	50.4	(81)
Northwest	0.9x	0.54	x	1.64	x	50.42	x	0.85	x	0.7	=	23.91	(81)
Northwest	0.9x	0.54	x	2.4	x	50.42	x	0.85	x	0.7	=	34.99	(81)
Northwest	0.9x	0.54	x	1.64	x	28.07	x	0.85	x	0.7	=	13.31	(81)
Northwest	0.9x	0.54	x	2.4	x	28.07	x	0.85	x	0.7	=	19.48	(81)
Northwest	0.9x	0.54	x	1.64	x	14.2	x	0.85	x	0.7	=	6.73	(81)
Northwest	0.9x	0.54	x	2.4	x	14.2	x	0.85	x	0.7	=	9.85	(81)
Northwest	0.9x	0.54	x	1.64	x	9.21	x	0.85	x	0.7	=	4.37	(81)
Northwest	0.9x	0.54	x	2.4	x	9.21	x	0.85	x	0.7	=	6.39	(81)

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

(83)m=	311.88	545.52	786.68	1046.09	1239.64	1261.31	1203.23	1053.66	875.44	613.55	376.1	265.29	(83)

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

(84)m=	1620.14	1844.78	2039.36	2226.54	2344.03	2300.52	2206.73	2070.79	1936.38	1746.98	1589.34	1540.9	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.95	0.88	0.91	0.97	0.99	1	1	(86)

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

(87)m=	18.62	18.78	19.09	19.56	20.03	20.49	20.75	20.71	20.34	19.73	19.13	18.63	(87)

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

(88)m=	19.32	19.33	19.33	19.37	19.38	19.41	19.41	19.41	19.4	19.38	19.36	19.35	(88)

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

(89)m=	1	1	1	0.99	0.97	0.89	0.73	0.78	0.95	0.99	1	1	(89)

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

(90)m=	16.24	16.47	16.93	17.64	18.33	18.99	19.29	19.26	18.78	17.9	17	16.27	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	16.57	16.8	17.24	17.91	18.57	19.2	19.5	19.46	19	18.16	17.3	16.6	(92)

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

(93)m=	16.57	16.8	17.24	17.91	18.57	19.2	19.5	19.46	19	18.16	17.3	16.6	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.96	0.88	0.74	0.78	0.93	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1615.63	1836.42	2022.37	2186.19	2239.42	2030.95	1630.77	1625.39	1808.05	1720.88	1582.15	1537.43	(95)

SAP WorkSheet: New dwelling design stage

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=	9134.63	8804.68	7902.17	6453.43	4894.48	3196.17	2015.39	2119.7	3437.04	5383.88	7344.55	9024.58	(97)

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

(98)m=	5594.13	4682.67	4374.57	3072.41	1975.36	0	0	0	0	2725.28	4148.93	5570.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 32143.8 (98)

Space heating requirement in kWh/m²/year 87.32 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	6533.46	5143.36	5258.13	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.39	0.46	0.43	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2537.45	2384.52	2238.54	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2603.99	2494.61	2316.32	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m; set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 0 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.38 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(107)$_{6...8}$ = 0 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0 (108)

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 0.1 (301)

Fraction of space heat from community system 1 – (301) = 0.9 (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) = 0.9 (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 32143.8

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SAP WorkSheet: New dwelling design stage

Space heat from Community boilers	(98) x (304a) x (305) x (306) =	30375.89	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		65	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	4945.2	(309)

Water heating

Annual water heating requirement		4084.59	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	4288.82	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	346.65	(313)
Cooling System Energy Efficiency Ratio		4.38	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		907.39	(332)

10b. Fuel costs – Community heating scheme

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	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	4.24	x 0.01 =	1287.94	(340a)
Space heating (secondary)	(309)	x	5.26	x 0.01 =	260.12	(341)
Water heating from CHP	(310a)	x	4.24	x 0.01 =	181.85	(342a)
			Fuel Price			
Pumps and fans	(331)		13.19	x 0.01 =	0	(349)
Energy for lighting	(332)		13.19	x 0.01 =	119.68	(350)
Additional standing charges (Table 12)					120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =				1969.59	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	2	(357)
SAP rating (section12)		72.07	(358)

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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	8228.11	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	179.91	(372)

SAP WorkSheet: New dwelling design stage

Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	8408.02	(373)
CO2 associated with space heating (secondary)	(309) x	0.04	=	192.86	(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) =			8600.88	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	470.94	(379)
Total CO2, kg/year	sum of (376)…(382) =			9071.82	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			24.64	(384)
EI rating (section 14)				70.57	(385)

13b. Primary Energy – Community heating scheme

		Energy kWh/year	Primary factor		P.Energy kWh/year	
Energy 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				91	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	46473.57	(367)
Electrical energy for heat distribution	[(313) x			=	1064.21	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	47537.78	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					47537.78	(373)
Energy associated with space heating (secondary)	(309) x		1.26	=	6230.95	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				53768.73	(376)
Energy associated with space cooling	(315) x		3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	0	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	2785.69	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =				56554.42	(383)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.75	(1a)	x	3.1	(2a)	=	172.82	(3a)
Ground floor	156.34	(1b)	x	2.6	(2b)	=	406.48	(3b)
First floor	156.01	(1c)	x	3.28	(2c)	=	511.71	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	368.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1091.02	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	1	=	2	x 40 =	80	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							6	x 10 =	60	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	140	÷ (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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.61	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	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

0.78	0.77	0.75	0.68	0.66	0.58	0.58	0.57	0.61	0.66	0.69	0.72

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(24d)

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

(25)m=	0.81	0.8	0.78	0.73	0.72	0.67	0.67	0.66	0.69	0.72	0.74	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x 2	= 4.2			(26)
Doors Type 2			1.64	x 2	= 3.28			(26)
Windows Type 1			1.5	x1/[1/(4.5)+ 0.04]	= 5.72			(27)
Windows Type 2			1.64	x1/[1/(4.5)+ 0.04]	= 6.25			(27)
Windows Type 3			1.64	x1/[1/(4.5)+ 0.04]	= 6.25			(27)
Windows Type 4			1.64	x1/[1/(4.5)+ 0.04]	= 6.25			(27)
Windows Type 5			1.64	x1/[1/(4.5)+ 0.04]	= 6.25			(27)
Windows Type 6			0.83	x1/[1/(4.5)+ 0.04]	= 3.17			(27)
Windows Type 7			1.64	x1/[1/(4.5)+ 0.04]	= 6.25			(27)
Windows Type 8			3.1	x1/[1/(2.1)+ 0.04]	= 6.01			(27)
Windows Type 9			5.13	x1/[1/(4.8)+ 0.04]	= 20.66			(27)
Windows Type 10			2.4	x1/[1/(4.5)+ 0.04]	= 9.15			(27)
Windows Type 11			2.4	x1/[1/(4.5)+ 0.04]	= 9.15			(27)
Windows Type 12			2.4	x1/[1/(4.5)+ 0.04]	= 9.15			(27)
Windows Type 13			2.83	x1/[1/(4.5)+ 0.04]	= 10.79			(27)
Floor Type 1			55.75	x 0.17	= 9.4775			(28)
Floor Type 2			100.58	x 0.2	= 20.116			(28)

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DER WorkSheet: New dwelling design stage

Floor Type 3			24.67	x	0.2	=	4.934			(28)
Walls Type1	87.11	0	87.11	x	0.15	=	13.07			(29)
Walls Type2	101.74	22.97	78.77	x	0.8	=	63.02			(29)
Walls Type3	43.34	0	43.34	x	0.17	=	7.35			(29)
Walls Type4	53.64	0	53.64	x	0.17	=	9.09			(29)
Walls Type5	119.93	20.82	99.11	x	0.8	=	79.29			(29)
Roof	23.62	0	23.62	x	0.15	=	3.54			(30)
Total area of elements, m²			612.48							(31)
Party wall			30.03	x	0	=	0			(32)
Party wall			25.87	x	0	=	0			(32)

** 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) =	361.74	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		91.87	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	453.62	(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=	290.64	286.34	282.13	262.36	258.66	241.43	241.43	238.24	248.07	258.66	266.14	273.97	(38)

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

(39)m=	744.26	739.96	735.75	715.97	712.27	695.05	695.05	691.86	701.68	712.27	719.76	727.58	

Average = Sum(39)$_{1…12}$ /12= 715.96 (39)

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

(40)m=	2.02	2.01	2	1.95	1.94	1.89	1.89	1.88	1.91	1.94	1.96	1.98	

Average = Sum(40)$_{1…12}$ /12= 1.95 (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 — 3.22 (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 — 110.69 (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=	121.75	117.33	112.9	108.47	104.04	99.62	99.62	104.04	108.47	112.9	117.33	121.75

Total = Sum(44)$_{1…12}$ = 1328.23 (44)

DER WorkSheet: New dwelling design stage

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=	180.56	157.92	162.96	142.07	136.32	117.63	109	125.08	126.58	147.51	161.02	174.86

Total = Sum(45)$_{1...12}$ = 1741.52 (45)

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

(46)m=	27.08	23.69	24.44	21.31	20.45	17.64	16.35	18.76	18.99	22.13	24.15	26.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 310 | (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) = | 310 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.04 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0.73 | (52)

Temperature factor from Table 2b | 0.6 | (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = | 5.67 | (54)

Enter (50) or (54) in (55) | 5.67 | (55)

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

(56)m=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	379.56	337.66	361.96	334.65	335.32	310.21	308	324.08	319.16	346.52	353.6	373.86	(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=	379.56	337.66	361.96	334.65	335.32	310.21	308	324.08	319.16	346.52	353.6	373.86

Output from water heater (annual)$_{1...12}$ | 4084.59 | (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=	219.24	196.3	213.38	201.3	204.53	193.18	195.44	200.79	196.15	208.25	207.61	217.34	(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

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(66)m=	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	(66)

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

(67)m=	51.71	45.93	37.35	28.28	21.14	17.84	19.28	25.06	33.64	42.71	49.85	53.14	(67)

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

(68)m=	511.33	516.64	503.27	474.8	438.87	405.1	382.54	377.23	390.6	419.07	455	488.77	(68)

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

(69)m=	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	(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=	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	-128.82	(71)

Water heating gains (Table 5)

(72)m=	294.67	292.12	286.81	279.59	274.9	268.3	262.69	269.88	272.43	279.9	288.34	292.13	(72)

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

(73)m=	929.02	925.99	898.73	853.97	806.22	762.55	735.82	743.48	767.98	812.99	864.5	905.35	(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	0.54	x	3.1	x	10.63	x	0.72	x	0.7	=	24.22	(74)
North	0.9x	0.54	x	2.83	x	10.63	x	0.85	x	0.7	=	26.11	(74)
North	0.9x	0.54	x	3.1	x	20.32	x	0.72	x	0.7	=	46.29	(74)
North	0.9x	0.54	x	2.83	x	20.32	x	0.85	x	0.7	=	49.89	(74)
North	0.9x	0.54	x	3.1	x	34.53	x	0.72	x	0.7	=	78.66	(74)
North	0.9x	0.54	x	2.83	x	34.53	x	0.85	x	0.7	=	84.77	(74)
North	0.9x	0.54	x	3.1	x	55.46	x	0.72	x	0.7	=	126.35	(74)
North	0.9x	0.54	x	2.83	x	55.46	x	0.85	x	0.7	=	136.17	(74)
North	0.9x	0.54	x	3.1	x	74.72	x	0.72	x	0.7	=	170.2	(74)
North	0.9x	0.54	x	2.83	x	74.72	x	0.85	x	0.7	=	183.43	(74)
North	0.9x	0.54	x	3.1	x	79.99	x	0.72	x	0.7	=	182.2	(74)
North	0.9x	0.54	x	2.83	x	79.99	x	0.85	x	0.7	=	196.37	(74)
North	0.9x	0.54	x	3.1	x	74.68	x	0.72	x	0.7	=	170.11	(74)
North	0.9x	0.54	x	2.83	x	74.68	x	0.85	x	0.7	=	183.33	(74)
North	0.9x	0.54	x	3.1	x	59.25	x	0.72	x	0.7	=	134.96	(74)
North	0.9x	0.54	x	2.83	x	59.25	x	0.85	x	0.7	=	145.45	(74)
North	0.9x	0.54	x	3.1	x	41.52	x	0.72	x	0.7	=	94.57	(74)
North	0.9x	0.54	x	2.83	x	41.52	x	0.85	x	0.7	=	101.93	(74)
North	0.9x	0.54	x	3.1	x	24.19	x	0.72	x	0.7	=	55.1	(74)
North	0.9x	0.54	x	2.83	x	24.19	x	0.85	x	0.7	=	59.39	(74)
North	0.9x	0.54	x	3.1	x	13.12	x	0.72	x	0.7	=	29.88	(74)

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North	0.9x	0.54	x	2.83	x	13.12	x	0.85	x	0.7	=	32.2	(74)
North	0.9x	0.54	x	3.1	x	8.86	x	0.72	x	0.7	=	20.19	(74)
North	0.9x	0.54	x	2.83	x	8.86	x	0.85	x	0.7	=	21.76	(74)
South	0.9x	0.3	x	1.5	x	46.75	x	0.85	x	0.7	=	22.53	(78)
South	0.9x	0.77	x	5.13	x	46.75	x	0.85	x	0.7	=	98.89	(78)
South	0.9x	0.3	x	1.5	x	76.57	x	0.85	x	0.7	=	36.9	(78)
South	0.9x	0.77	x	5.13	x	76.57	x	0.85	x	0.7	=	161.96	(78)
South	0.9x	0.3	x	1.5	x	97.53	x	0.85	x	0.7	=	47.01	(78)
South	0.9x	0.77	x	5.13	x	97.53	x	0.85	x	0.7	=	206.31	(78)
South	0.9x	0.3	x	1.5	x	110.23	x	0.85	x	0.7	=	53.13	(78)
South	0.9x	0.77	x	5.13	x	110.23	x	0.85	x	0.7	=	233.18	(78)
South	0.9x	0.3	x	1.5	x	114.87	x	0.85	x	0.7	=	55.36	(78)
South	0.9x	0.77	x	5.13	x	114.87	x	0.85	x	0.7	=	242.98	(78)
South	0.9x	0.3	x	1.5	x	110.55	x	0.85	x	0.7	=	53.28	(78)
South	0.9x	0.77	x	5.13	x	110.55	x	0.85	x	0.7	=	233.84	(78)
South	0.9x	0.3	x	1.5	x	108.01	x	0.85	x	0.7	=	52.06	(78)
South	0.9x	0.77	x	5.13	x	108.01	x	0.85	x	0.7	=	228.48	(78)
South	0.9x	0.3	x	1.5	x	104.89	x	0.85	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	5.13	x	104.89	x	0.85	x	0.7	=	221.88	(78)
South	0.9x	0.3	x	1.5	x	101.89	x	0.85	x	0.7	=	49.1	(78)
South	0.9x	0.77	x	5.13	x	101.89	x	0.85	x	0.7	=	215.52	(78)
South	0.9x	0.3	x	1.5	x	82.59	x	0.85	x	0.7	=	39.8	(78)
South	0.9x	0.77	x	5.13	x	82.59	x	0.85	x	0.7	=	174.69	(78)
South	0.9x	0.3	x	1.5	x	55.42	x	0.85	x	0.7	=	26.71	(78)
South	0.9x	0.77	x	5.13	x	55.42	x	0.85	x	0.7	=	117.22	(78)
South	0.9x	0.3	x	1.5	x	40.4	x	0.85	x	0.7	=	19.47	(78)
South	0.9x	0.77	x	5.13	x	40.4	x	0.85	x	0.7	=	85.45	(78)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	1.64	x	36.79		0.85	x	0.7	=	17.45	(79)
Southwest	0.9x	0.54	x	2.4	x	36.79		0.85	x	0.7	=	25.54	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	1.64	x	62.67		0.85	x	0.7	=	29.72	(79)
Southwest	0.9x	0.54	x	2.4	x	62.67		0.85	x	0.7	=	43.5	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	1.64	x	85.75		0.85	x	0.7	=	40.67	(79)
Southwest	0.9x	0.54	x	2.4	x	85.75		0.85	x	0.7	=	59.51	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	1.64	x	106.25		0.85	x	0.7	=	50.39	(79)
Southwest	0.9x	0.54	x	2.4	x	106.25		0.85	x	0.7	=	73.74	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)
Southwest	0.9x	0.54	x	1.64	x	119.01		0.85	x	0.7	=	56.44	(79)

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Southwest	0.9x	0.54	x	2.4	x	119.01		0.85	x	0.7	=	82.59	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	1.64	x	118.15		0.85	x	0.7	=	56.03	(79)
Southwest	0.9x	0.54	x	2.4	x	118.15		0.85	x	0.7	=	82	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	1.64	x	113.91		0.85	x	0.7	=	54.02	(79)
Southwest	0.9x	0.54	x	2.4	x	113.91		0.85	x	0.7	=	79.05	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	1.64	x	104.39		0.85	x	0.7	=	49.51	(79)
Southwest	0.9x	0.54	x	2.4	x	104.39		0.85	x	0.7	=	72.45	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	1.64	x	92.85		0.85	x	0.7	=	44.03	(79)
Southwest	0.9x	0.54	x	2.4	x	92.85		0.85	x	0.7	=	64.44	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	1.64	x	69.27		0.85	x	0.7	=	32.85	(79)
Southwest	0.9x	0.54	x	2.4	x	69.27		0.85	x	0.7	=	48.07	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	1.64	x	44.07		0.85	x	0.7	=	20.9	(79)
Southwest	0.9x	0.54	x	2.4	x	44.07		0.85	x	0.7	=	30.59	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	1.64	x	31.49		0.85	x	0.7	=	14.93	(79)
Southwest	0.9x	0.54	x	2.4	x	31.49		0.85	x	0.7	=	21.85	(79)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	1.64	x	19.64	x	0.85	x	0.7	=	9.31	(80)
West	0.9x	0.54	x	0.83	x	19.64	x	0.85	x	0.7	=	4.71	(80)
West	0.9x	0.54	x	2.4	x	19.64	x	0.85	x	0.7	=	13.63	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	1.64	x	38.42	x	0.85	x	0.7	=	18.22	(80)
West	0.9x	0.54	x	0.83	x	38.42	x	0.85	x	0.7	=	9.22	(80)
West	0.9x	0.54	x	2.4	x	38.42	x	0.85	x	0.7	=	26.66	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	1.64	x	63.27	x	0.85	x	0.7	=	30.01	(80)
West	0.9x	0.54	x	0.83	x	63.27	x	0.85	x	0.7	=	15.19	(80)
West	0.9x	0.54	x	2.4	x	63.27	x	0.85	x	0.7	=	43.91	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	1.64	x	92.28	x	0.85	x	0.7	=	43.76	(80)
West	0.9x	0.54	x	0.83	x	92.28	x	0.85	x	0.7	=	22.15	(80)
West	0.9x	0.54	x	2.4	x	92.28	x	0.85	x	0.7	=	64.04	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	1.64	x	113.09	x	0.85	x	0.7	=	53.63	(80)
West	0.9x	0.54	x	0.83	x	113.09	x	0.85	x	0.7	=	27.14	(80)

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DER WorkSheet: New dwelling design stage

West	0.9x	0.54	x	2.4	x	113.09	x	0.85	x	0.7	=	78.49	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	1.64	x	115.77	x	0.85	x	0.7	=	54.9	(80)
West	0.9x	0.54	x	0.83	x	115.77	x	0.85	x	0.7	=	27.79	(80)
West	0.9x	0.54	x	2.4	x	115.77	x	0.85	x	0.7	=	80.35	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	1.64	x	110.22	x	0.85	x	0.7	=	52.27	(80)
West	0.9x	0.54	x	0.83	x	110.22	x	0.85	x	0.7	=	26.45	(80)
West	0.9x	0.54	x	2.4	x	110.22	x	0.85	x	0.7	=	76.49	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	1.64	x	94.68	x	0.85	x	0.7	=	44.9	(80)
West	0.9x	0.54	x	0.83	x	94.68	x	0.85	x	0.7	=	22.72	(80)
West	0.9x	0.54	x	2.4	x	94.68	x	0.85	x	0.7	=	65.71	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	1.64	x	73.59	x	0.85	x	0.7	=	34.9	(80)
West	0.9x	0.54	x	0.83	x	73.59	x	0.85	x	0.7	=	17.66	(80)
West	0.9x	0.54	x	2.4	x	73.59	x	0.85	x	0.7	=	51.07	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	1.64	x	45.59	x	0.85	x	0.7	=	21.62	(80)
West	0.9x	0.54	x	0.83	x	45.59	x	0.85	x	0.7	=	10.94	(80)
West	0.9x	0.54	x	2.4	x	45.59	x	0.85	x	0.7	=	31.64	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	1.64	x	24.49	x	0.85	x	0.7	=	11.61	(80)
West	0.9x	0.54	x	0.83	x	24.49	x	0.85	x	0.7	=	5.88	(80)
West	0.9x	0.54	x	2.4	x	24.49	x	0.85	x	0.7	=	17	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	1.64	x	16.15	x	0.85	x	0.7	=	7.66	(80)
West	0.9x	0.54	x	0.83	x	16.15	x	0.85	x	0.7	=	3.88	(80)
West	0.9x	0.54	x	2.4	x	16.15	x	0.85	x	0.7	=	11.21	(80)
Northwest	0.9x	0.54	x	1.64	x	11.28	x	0.85	x	0.7	=	5.35	(81)
Northwest	0.9x	0.54	x	2.4	x	11.28	x	0.85	x	0.7	=	7.83	(81)
Northwest	0.9x	0.54	x	1.64	x	22.97	x	0.85	x	0.7	=	10.89	(81)
Northwest	0.9x	0.54	x	2.4	x	22.97	x	0.85	x	0.7	=	15.94	(81)
Northwest	0.9x	0.54	x	1.64	x	41.38	x	0.85	x	0.7	=	19.62	(81)
Northwest	0.9x	0.54	x	2.4	x	41.38	x	0.85	x	0.7	=	28.72	(81)
Northwest	0.9x	0.54	x	1.64	x	67.96	x	0.85	x	0.7	=	32.23	(81)
Northwest	0.9x	0.54	x	2.4	x	67.96	x	0.85	x	0.7	=	47.16	(81)
Northwest	0.9x	0.54	x	1.64	x	91.35	x	0.85	x	0.7	=	43.32	(81)
Northwest	0.9x	0.54	x	2.4	x	91.35	x	0.85	x	0.7	=	63.39	(81)
Northwest	0.9x	0.54	x	1.64	x	97.38	x	0.85	x	0.7	=	46.18	(81)
Northwest	0.9x	0.54	x	2.4	x	97.38	x	0.85	x	0.7	=	67.59	(81)

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Northwest	0.9x	0.54	x	1.64	x	91.1	x	0.85	x	0.7	=	43.2	(81)
Northwest	0.9x	0.54	x	2.4	x	91.1	x	0.85	x	0.7	=	63.22	(81)
Northwest	0.9x	0.54	x	1.64	x	72.63	x	0.85	x	0.7	=	34.44	(81)
Northwest	0.9x	0.54	x	2.4	x	72.63	x	0.85	x	0.7	=	50.4	(81)
Northwest	0.9x	0.54	x	1.64	x	50.42	x	0.85	x	0.7	=	23.91	(81)
Northwest	0.9x	0.54	x	2.4	x	50.42	x	0.85	x	0.7	=	34.99	(81)
Northwest	0.9x	0.54	x	1.64	x	28.07	x	0.85	x	0.7	=	13.31	(81)
Northwest	0.9x	0.54	x	2.4	x	28.07	x	0.85	x	0.7	=	19.48	(81)
Northwest	0.9x	0.54	x	1.64	x	14.2	x	0.85	x	0.7	=	6.73	(81)
Northwest	0.9x	0.54	x	2.4	x	14.2	x	0.85	x	0.7	=	9.85	(81)
Northwest	0.9x	0.54	x	1.64	x	9.21	x	0.85	x	0.7	=	4.37	(81)
Northwest	0.9x	0.54	x	2.4	x	9.21	x	0.85	x	0.7	=	6.39	(81)

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

(83)m=	282.34	497.14	725.05	976.44	1167.06	1191.46	1134.99	987.38	811.06	561.36	341.09	239.77	(83)

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

(84)m=	1211.36	1423.13	1623.78	1830.42	1973.28	1954.01	1870.81	1730.86	1579.05	1374.36	1205.59	1145.12	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	0.99	0.97	0.92	0.94	0.99	1	1	1	(86)

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

(87)m=	18.53	18.69	19	19.48	19.96	20.42	20.7	20.65	20.26	19.65	19.04	18.54	(87)

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

(88)m=	19.32	19.33	19.33	19.37	19.38	19.41	19.41	19.41	19.4	19.38	19.36	19.35	(88)

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

(89)m=	1	1	1	0.99	0.98	0.93	0.79	0.84	0.97	1	1	1	(89)

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

(90)m=	16.1	16.34	16.8	17.52	18.22	18.91	19.25	19.21	18.68	17.78	16.88	16.14	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	16.45	16.67	17.11	17.79	18.47	19.12	19.46	19.41	18.9	18.05	17.19	16.48	(92)

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

(93)m=	16.45	16.67	17.11	17.79	18.47	19.12	19.46	19.41	18.9	18.05	17.19	16.48	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.97	0.92	0.8	0.84	0.96	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1209.95	1420.13	1616.74	1811.05	1915.82	1790.95	1493.06	1457.12	1514.42	1363.9	1203.21	1144.08	(95)

DER WorkSheet: New dwelling design stage

Monthly average external temperature from Table 8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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=	9041.3	8709.09	7808.98	6368.06	4819.99	3141.98	1986.7	2083.81	3370.02	5303.23	7259.19	8935.54	(97)

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

(98)m=	5826.53	4898.18	4607.03	3281.05	2160.7	0	0	0	0	2930.86	4360.3	5796.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 33861.5 | (98)

Space heating requirement in kWh/m²/year | 91.99 | (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	6533.46	5143.36	5258.13	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.38	0.46	0.42	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2510.29	2359.87	2213.68	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2573.9	2465.24	2287.9	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(104)$_{6..8}$ = | 0 | (104)

Cooled fraction — f C = cooled area ÷ (4) = | 0.38 | (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6..8}$ = | 0 | (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(107)$_{6..8}$ = | 0 | (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = | 0 | (108)

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	0.1	(301)
Fraction of space heat from community system 1 – (301) =	0.9	(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) =	0.9	(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 | 33861.5

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Space heat from Community boilers	(98) x (304a) x (305) x (306) =	31999.11	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		65	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	5209.46	(309)

Water heating

Annual water heating requirement		4084.59	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	4288.82	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	362.88	(313)
Cooling System Energy Efficiency Ratio		4.38	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		913.16	(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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	8613.4	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	188.33	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	8801.73	(373)
CO2 associated with space heating (secondary)	(309) x		0.04	=	203.17	(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) =				9004.9	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	473.93	(379)

Total CO2, kg/year	sum of (376)…(382) =	9478.83	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	25.75	(384)
EI rating (section 14)		69.25	(385)

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SAP Input

Property Details: Flat 5

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2015	
Floor Location:	Floor area:	Storey height:
Floor 0	91.6 m²	3.28 m
Floor 1	84.96 m²	2.65 m
Living area:	54.11 m² (fraction 0.591)	
Front of dwelling faces:	Unspecified	

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
d2	Manufacturer	Half glazed	low-E, En = 0.2, hard coat	No	Wood
W1	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	Wood
W2	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
W3	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
W4	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
w5	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
W6	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
w7	Manufacturer	Windows	low-E, En = 0.2, hard coat	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
d2	16mm or more mm	0.7	0.65	2	2.06	1
W1	16mm or more	0.7	0.65	1.5	1.93	2
W2	16mm or more	0.7	0.65	1.5	1.8	4
W3	16mm or more	0.7	0.65	1.5	1.8	3
W4	16mm or more	0.7	0.85	1.5	1.84	2
w5	16mm or more	0.7	0.85	1.5	1.43	3
W6	16mm or more	0.7	0.85	1.5	1.43	2
w7	16mm or more	0.7	0.85	1.5	1.43	3
RF1	16mm or more	0.7	0.65	1.5	1.2	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
d2		External wall GF	South	0.98	2.1
W1		External wall GF	South	0.963	2
W2		External wall GF	South	1	1.8
W3		External wall GF	East	1	1.8

SAP Input

W4	External wall GF	North	1.02	1.8
w5	External wall GF	North	1.02	1.4
W6	External wall GF	East	1.02	1.4
w7	External wall GF	South	1.02	1.4
RF1	Flat roof 2	Horizontal	1.518	0.792

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External wall GF	110.667	33.64	77.03	0.8	0	False	N/A
corridor GF	21.14	0	21.14	0.2	0.9	False	N/A
External FF	48.075	0	48.08	0.8	0	False	N/A
flat roof 1	39.87	0	39.87	0.15	0		N/A
Flat roof 2	84.96	1.2	83.76	0.15	0		N/A
above garage	68.67			0.2			N/A
Internal Elements							
Party Elements							
party GF	71.63						N/A
Party wall FF	118.11						N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

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Ventilation:

Pressure test:	No (Assumed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	1 (main: 0, secondary: 0, other: 1)
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	15

Main heating system:

Main heating system:
Community heating schemes
Heat source: Community boilers
heat from boilers – mains gas, heat fraction 1, efficiency 91
Piping>=1991, pre-insulated, low temp, variable flow

Main heating Control:

Main heating Control:
Charging system linked to use of community heating, programmer and at least two room thermosta
Control code: 2312

Secondary heating system:

Secondary heating system: None

Space cooling system:

Space cooling system:
Split/multiple systems
Tested data to EN 14511:
Brand/Model: tbc
EER: 3.5
Compressor control: Systems with On/Off control
Cooled area: 140 (fraction 0.793)

Water heating:

Water heating:
From main heating system
Water code: 901

SAP Input

Fuel :heat from boilers – mains gas
Hot water cylinder
Cylinder volume: 250 litres
Cylinder insulation: Jacket 35 mm
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	91.6	(1a)	x	3.28	(2a)	=	300.45	(3a)
First floor	84.96	(1b)	x	2.65	(2b)	=	225.14	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	176.56	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	525.59	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	60	÷ (5) =	0.11	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.86	(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) =	0.73	(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

SAP WorkSheet: New dwelling design stage

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

0.94	0.92	0.9	0.81	0.79	0.7	0.7	0.68	0.73	0.79	0.83	0.86

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=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(24d)

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

(25)m=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x	2	=	4.2			(26)
Doors Type 2			2.06	x	2	=	4.12			(26)
Windows Type 1			1.93	x1/[1/(1.5)+ 0.04]		=	2.73			(27)
Windows Type 2			1.8	x1/[1/(1.5)+ 0.04]		=	2.55			(27)
Windows Type 3			1.8	x1/[1/(1.5)+ 0.04]		=	2.55			(27)
Windows Type 4			1.84	x1/[1/(1.5)+ 0.04]		=	2.6			(27)
Windows Type 5			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Windows Type 6			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Windows Type 7			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Rooflights			1.2	x1/[1/(1.5) + 0.04]		=	1.8			(27b)
Floor			68.67	x	0.2	=	13.734			(28)
Walls Type1	110.67	33.64	77.03	x	0.8	=	61.62			(29)
Walls Type2	21.14	0	21.14	x	0.17	=	3.58			(29)
Walls Type3	48.08	0	48.08	x	0.8	=	38.46			(29)
Roof Type1	39.87	0	39.87	x	0.15	=	5.98			(30)
Roof Type2	84.96	1.2	83.76	x	0.15	=	12.56			(30)
Total area of elements, m²			375.48							(31)

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SAP WorkSheet: New dwelling design stage

Party wall	71.63	x	0	=	0			(32)
Party wall	118.11	x	0	=	0			(32)

** 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) =	190.65	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		56.32	(36)

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

Total fabric heat loss	(33) + (36) =	246.97	(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=	162.79	159.83	156.94	143.34	140.79	128.95	128.95	126.76	133.51	140.79	145.94	151.32	(38)

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

(39)m=	409.76	406.8	403.91	390.31	387.77	375.92	375.92	373.73	380.49	387.77	392.91	398.29	

Average = Sum(39)$_{1…12}$ /12= 390.3 (39)

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

(40)m=	2.32	2.3	2.29	2.21	2.2	2.13	2.13	2.12	2.15	2.2	2.23	2.26	

Average = Sum(40)$_{1…12}$ /12= 2.21 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.97 (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) + 36 104.77 (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=	115.24	111.05	106.86	102.67	98.48	94.29	94.29	98.48	102.67	106.86	111.05	115.24	

Total = Sum(44)$_{1…12}$ = 1257.22 (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=	170.9	149.47	154.24	134.47	129.03	111.34	103.18	118.4	119.81	139.63	152.41	165.51	

Total = Sum(45)$_{1…12}$ = 1648.41 (45)

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

(46)m=	25.64	22.42	23.14	20.17	19.35	16.7	15.48	17.76	17.97	20.94	22.86	24.83	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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:

SAP WorkSheet: New dwelling design stage

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.04	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	4.91	(54)
Enter (50) or (54) in (55)		4.91	(55)

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

(56)m=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	346.43	308.01	329.77	304.33	304.55	281.2	278.7	293.92	289.67	315.15	322.27	341.03	(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=	346.43	308.01	329.77	304.33	304.55	281.2	278.7	293.92	289.67	315.15	322.27	341.03

Output from water heater (annual)$_{1...12}$ — 3715.04 (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=	197.24	176.53	191.7	180.6	183.32	172.91	174.72	179.78	175.73	186.84	186.57	195.45	(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=	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	178.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	77.6	68.93	56.05	42.44	31.72	26.78	28.94	37.61	50.49	64.1	74.82	79.76	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	519.67	525.07	511.48	482.55	446.03	411.71	388.78	383.39	396.97	425.9	462.42	496.75	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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SAP WorkSheet: New dwelling design stage

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

(71)m=	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	(71)

Water heating gains (Table 5)

(72)m=	265.11	262.69	257.67	250.83	246.4	240.15	234.84	241.65	244.06	251.13	259.12	262.7	(72)

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

(73)m=	977.61	971.91	940.42	891.04	839.37	793.87	767.78	777.87	806.75	856.37	911.58	954.43	(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	1	x	1.84	x	10.63	x	0.85	x	0.7	=	20.95	(74)
North	0.9x	1	x	1.43	x	10.63	x	0.85	x	0.7	=	24.43	(74)
North	0.9x	1	x	1.84	x	20.32	x	0.85	x	0.7	=	40.05	(74)
North	0.9x	1	x	1.43	x	20.32	x	0.85	x	0.7	=	46.68	(74)
North	0.9x	1	x	1.84	x	34.53	x	0.85	x	0.7	=	68.05	(74)
North	0.9x	1	x	1.43	x	34.53	x	0.85	x	0.7	=	79.33	(74)
North	0.9x	1	x	1.84	x	55.46	x	0.85	x	0.7	=	109.3	(74)
North	0.9x	1	x	1.43	x	55.46	x	0.85	x	0.7	=	127.42	(74)
North	0.9x	1	x	1.84	x	74.72	x	0.85	x	0.7	=	147.24	(74)
North	0.9x	1	x	1.43	x	74.72	x	0.85	x	0.7	=	171.64	(74)
North	0.9x	1	x	1.84	x	79.99	x	0.85	x	0.7	=	157.62	(74)
North	0.9x	1	x	1.43	x	79.99	x	0.85	x	0.7	=	183.75	(74)
North	0.9x	1	x	1.84	x	74.68	x	0.85	x	0.7	=	147.16	(74)
North	0.9x	1	x	1.43	x	74.68	x	0.85	x	0.7	=	171.55	(74)
North	0.9x	1	x	1.84	x	59.25	x	0.85	x	0.7	=	116.75	(74)
North	0.9x	1	x	1.43	x	59.25	x	0.85	x	0.7	=	136.11	(74)
North	0.9x	1	x	1.84	x	41.52	x	0.85	x	0.7	=	81.81	(74)
North	0.9x	1	x	1.43	x	41.52	x	0.85	x	0.7	=	95.38	(74)
North	0.9x	1	x	1.84	x	24.19	x	0.85	x	0.7	=	47.67	(74)
North	0.9x	1	x	1.43	x	24.19	x	0.85	x	0.7	=	55.57	(74)
North	0.9x	1	x	1.84	x	13.12	x	0.85	x	0.7	=	25.85	(74)
North	0.9x	1	x	1.43	x	13.12	x	0.85	x	0.7	=	30.14	(74)
North	0.9x	1	x	1.84	x	8.86	x	0.85	x	0.7	=	17.47	(74)
North	0.9x	1	x	1.43	x	8.86	x	0.85	x	0.7	=	20.36	(74)
East	0.9x	3	x	1.8	x	19.64	x	0.65	x	0.7	=	43.43	(76)
East	0.9x	2	x	1.43	x	19.64	x	0.85	x	0.7	=	30.08	(76)
East	0.9x	3	x	1.8	x	38.42	x	0.65	x	0.7	=	84.96	(76)
East	0.9x	2	x	1.43	x	38.42	x	0.85	x	0.7	=	58.84	(76)
East	0.9x	3	x	1.8	x	63.27	x	0.65	x	0.7	=	139.92	(76)
East	0.9x	2	x	1.43	x	63.27	x	0.85	x	0.7	=	96.9	(76)

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SAP WorkSheet: New dwelling design stage

East	0.9x	3	x	1.8	x	92.28	x	0.65	x	0.7	=	204.06	(76)
East	0.9x	2	x	1.43	x	92.28	x	0.85	x	0.7	=	141.33	(76)
East	0.9x	3	x	1.8	x	113.09	x	0.65	x	0.7	=	250.08	(76)
East	0.9x	2	x	1.43	x	113.09	x	0.85	x	0.7	=	173.2	(76)
East	0.9x	3	x	1.8	x	115.77	x	0.65	x	0.7	=	256	(76)
East	0.9x	2	x	1.43	x	115.77	x	0.85	x	0.7	=	177.31	(76)
East	0.9x	3	x	1.8	x	110.22	x	0.65	x	0.7	=	243.73	(76)
East	0.9x	2	x	1.43	x	110.22	x	0.85	x	0.7	=	168.8	(76)
East	0.9x	3	x	1.8	x	94.68	x	0.65	x	0.7	=	209.36	(76)
East	0.9x	2	x	1.43	x	94.68	x	0.85	x	0.7	=	145	(76)
East	0.9x	3	x	1.8	x	73.59	x	0.65	x	0.7	=	162.73	(76)
East	0.9x	2	x	1.43	x	73.59	x	0.85	x	0.7	=	112.7	(76)
East	0.9x	3	x	1.8	x	45.59	x	0.65	x	0.7	=	100.81	(76)
East	0.9x	2	x	1.43	x	45.59	x	0.85	x	0.7	=	69.82	(76)
East	0.9x	3	x	1.8	x	24.49	x	0.65	x	0.7	=	54.15	(76)
East	0.9x	2	x	1.43	x	24.49	x	0.85	x	0.7	=	37.51	(76)
East	0.9x	3	x	1.8	x	16.15	x	0.65	x	0.7	=	35.72	(76)
East	0.9x	2	x	1.43	x	16.15	x	0.85	x	0.7	=	24.74	(76)
South	0.9x	1	x	1.93	x	46.75	x	0.65	x	0.7	=	73.9	(78)
South	0.9x	1	x	1.8	x	46.75	x	0.65	x	0.7	=	137.84	(78)
South	0.9x	1	x	1.43	x	46.75	x	0.85	x	0.7	=	107.4	(78)
South	0.9x	1	x	1.93	x	76.57	x	0.65	x	0.7	=	121.03	(78)
South	0.9x	1	x	1.8	x	76.57	x	0.65	x	0.7	=	225.75	(78)
South	0.9x	1	x	1.43	x	76.57	x	0.85	x	0.7	=	175.9	(78)
South	0.9x	1	x	1.93	x	97.53	x	0.65	x	0.7	=	154.17	(78)
South	0.9x	1	x	1.8	x	97.53	x	0.65	x	0.7	=	287.57	(78)
South	0.9x	1	x	1.43	x	97.53	x	0.85	x	0.7	=	224.06	(78)
South	0.9x	1	x	1.93	x	110.23	x	0.65	x	0.7	=	174.24	(78)
South	0.9x	1	x	1.8	x	110.23	x	0.65	x	0.7	=	325.02	(78)
South	0.9x	1	x	1.43	x	110.23	x	0.85	x	0.7	=	253.24	(78)
South	0.9x	1	x	1.93	x	114.87	x	0.65	x	0.7	=	181.57	(78)
South	0.9x	1	x	1.8	x	114.87	x	0.65	x	0.7	=	338.69	(78)
South	0.9x	1	x	1.43	x	114.87	x	0.85	x	0.7	=	263.89	(78)
South	0.9x	1	x	1.93	x	110.55	x	0.65	x	0.7	=	174.74	(78)
South	0.9x	1	x	1.8	x	110.55	x	0.65	x	0.7	=	325.94	(78)
South	0.9x	1	x	1.43	x	110.55	x	0.85	x	0.7	=	253.96	(78)
South	0.9x	1	x	1.93	x	108.01	x	0.65	x	0.7	=	170.73	(78)
South	0.9x	1	x	1.8	x	108.01	x	0.65	x	0.7	=	318.46	(78)
South	0.9x	1	x	1.43	x	108.01	x	0.85	x	0.7	=	248.14	(78)
South	0.9x	1	x	1.93	x	104.89	x	0.65	x	0.7	=	165.8	(78)
South	0.9x	1	x	1.8	x	104.89	x	0.65	x	0.7	=	309.27	(78)

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SAP WorkSheet: New dwelling design stage

South	0.9x	1	x	1.43	x	104.89	x	0.85	x	0.7	=	240.97	(78)
South	0.9x	1	x	1.93	x	101.89	x	0.65	x	0.7	=	161.05	(78)
South	0.9x	1	x	1.8	x	101.89	x	0.65	x	0.7	=	300.4	(78)
South	0.9x	1	x	1.43	x	101.89	x	0.85	x	0.7	=	234.06	(78)
South	0.9x	1	x	1.93	x	82.59	x	0.65	x	0.7	=	130.54	(78)
South	0.9x	1	x	1.8	x	82.59	x	0.65	x	0.7	=	243.5	(78)
South	0.9x	1	x	1.43	x	82.59	x	0.85	x	0.7	=	189.72	(78)
South	0.9x	1	x	1.93	x	55.42	x	0.65	x	0.7	=	87.6	(78)
South	0.9x	1	x	1.8	x	55.42	x	0.65	x	0.7	=	163.39	(78)
South	0.9x	1	x	1.43	x	55.42	x	0.85	x	0.7	=	127.31	(78)
South	0.9x	1	x	1.93	x	40.4	x	0.65	x	0.7	=	63.86	(78)
South	0.9x	1	x	1.8	x	40.4	x	0.65	x	0.7	=	119.11	(78)
South	0.9x	1	x	1.43	x	40.4	x	0.85	x	0.7	=	92.81	(78)
Rooflights	0.9x	1	x	1.2	x	26	x	0.65	x	0.7	=	12.78	(82)
Rooflights	0.9x	1	x	1.2	x	54	x	0.65	x	0.7	=	26.54	(82)
Rooflights	0.9x	1	x	1.2	x	96	x	0.65	x	0.7	=	47.17	(82)
Rooflights	0.9x	1	x	1.2	x	150	x	0.65	x	0.7	=	73.71	(82)
Rooflights	0.9x	1	x	1.2	x	192	x	0.65	x	0.7	=	94.35	(82)
Rooflights	0.9x	1	x	1.2	x	200	x	0.65	x	0.7	=	98.28	(82)
Rooflights	0.9x	1	x	1.2	x	189	x	0.65	x	0.7	=	92.87	(82)
Rooflights	0.9x	1	x	1.2	x	157	x	0.65	x	0.7	=	77.15	(82)
Rooflights	0.9x	1	x	1.2	x	115	x	0.65	x	0.7	=	56.51	(82)
Rooflights	0.9x	1	x	1.2	x	66	x	0.65	x	0.7	=	32.43	(82)
Rooflights	0.9x	1	x	1.2	x	33	x	0.65	x	0.7	=	16.22	(82)
Rooflights	0.9x	1	x	1.2	x	21	x	0.65	x	0.7	=	10.32	(82)

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

(83)m=	450.82	779.75	1097.17	1408.32	1620.67	1627.6	1561.45	1400.41	1204.64	870.06	542.16	384.38	(83)

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

(84)m=	1428.43	1751.66	2037.59	2299.36	2460.04	2421.47	2329.23	2178.28	2011.39	1726.43	1453.74	1338.81	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.88	0.76	0.62	0.66	0.85	0.96	0.99	0.99	(86)

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

(87)m=	18.62	18.88	19.29	19.86	20.35	20.74	20.9	20.88	20.59	19.94	19.21	18.63	(87)

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

(88)m=	19.13	19.14	19.15	19.2	19.21	19.25	19.25	19.26	19.23	19.21	19.19	19.17	(88)

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

(89)m=	0.99	0.98	0.96	0.92	0.82	0.63	0.41	0.46	0.75	0.93	0.98	0.99	(89)

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

SAP WorkSheet: New dwelling design stage

(90)m=	16.13	16.52	17.12	17.95	18.61	19.1	19.22	19.22	18.94	18.08	17.02	16.16	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	16.9	17.24	17.78	18.53	19.15	19.6	19.74	19.73	19.44	18.65	17.69	16.92	(92)

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

(93)m=	16.9	17.24	17.78	18.53	19.15	19.6	19.74	19.73	19.44	18.65	17.69	16.92	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.9	0.81	0.66	0.48	0.53	0.76	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1406.26	1702.96	1934.78	2074.27	2001.14	1591.22	1108.25	1144.38	1534.52	1592.07	1416.19	1321.77	(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=	5161.6	5020.08	4557.4	3759.9	2887.96	1879.6	1179.58	1243.11	2032.66	3120.22	4162.17	5065.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2793.98	2229.1	1951.23	1213.65	659.79	0	0	0	0	1136.94	1977.11	2785.43	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 14747.23 (98)

Space heating requirement in kWh/m²/year 83.53 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	3533.68	2781.83	2840.35	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.6	0.69	0.65	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2132.14	1917.24	1853.44	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2421.47	2329.23	2178.28	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	0	306.52	241.69	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 548.21 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.79 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	60.76	47.91	0	0	0	0

Total = Sum(107)$_{6...8}$ = 108.67 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.62 (108)

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SAP WorkSheet: New dwelling design stage

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		14747.23	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	15484.59	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		3715.04	
If DHW from community scheme:			
Water heat from Community boilers	(64) x (303a) x (305) x (306) =	3900.79	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	193.85	(313)
Cooling System Energy Efficiency Ratio		4.38	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	24.84	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		548.19	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a)	x	4.24	x 0.01 =	656.55	(340a)
Water heating from CHP	(310a)	x	4.24	x 0.01 =	165.39	(342a)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	3.28	(348)
Pumps and fans	(331)		13.19	x 0.01 =	0	(349)
Energy for lighting	(332)		13.19	x 0.01 =	72.31	(350)
Additional standing charges (Table 12)					120	(351)

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SAP WorkSheet: New dwelling design stage

Total energy cost	= (340a)…(342e) + (345)…(354) =	1017.52	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.93	(357)
SAP rating (section12)		73.09	(358)

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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	4601.37	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	100.61	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	4701.98	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				4701.98	(376)
CO2 associated with space cooling	(315) x		0.52	=	12.89	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	284.51	(379)
Total CO2, kg/year	sum of (376)…(382) =				4999.38	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				28.32	(384)
EI rating (section 14)					69.76	(385)

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13b. Primary Energy – Community heating scheme

		Energy kWh/year	Primary factor		P.Energy kWh/year	
Energy 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				91	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	25989.2	(367)
Electrical energy for heat distribution	[(313) x			=	595.13	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	26584.33	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					26584.33	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				26584.33	(376)
Energy associated with space cooling	(315) x		3.07	=	76.26	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	0	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	1682.94	(379)

Total Primary Energy, kWh/year	sum of (376)…(382) =	28343.52	(383)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	91.6	(1a)	x	3.28	(2a)	=	300.45	(3a)
First floor	84.96	(1b)	x	2.65	(2b)	=	225.14	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	176.56	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	525.59	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	60	÷ (5) =	0.11	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.86	(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) =	0.73	(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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DER WorkSheet: New dwelling design stage

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

	0.94	0.92	0.9	0.81	0.79	0.7	0.7	0.68	0.73	0.79	0.83	0.86

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=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(24d)

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

(25)m=	0.94	0.92	0.9	0.83	0.81	0.74	0.74	0.73	0.77	0.81	0.84	0.87	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.1	x	2	=	4.2			(26)
Doors Type 2			2.06	x	2	=	4.12			(26)
Windows Type 1			1.93	x1/[1/(1.5)+ 0.04]		=	2.73			(27)
Windows Type 2			1.8	x1/[1/(1.5)+ 0.04]		=	2.55			(27)
Windows Type 3			1.8	x1/[1/(1.5)+ 0.04]		=	2.55			(27)
Windows Type 4			1.84	x1/[1/(1.5)+ 0.04]		=	2.6			(27)
Windows Type 5			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Windows Type 6			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Windows Type 7			1.43	x1/[1/(1.5)+ 0.04]		=	2.02			(27)
Rooflights			1.2	x1/[1/(1.5) + 0.04]		=	1.8			(27b)
Floor			68.67	x	0.2	=	13.734			(28)
Walls Type1	110.67	33.64	77.03	x	0.8	=	61.62			(29)
Walls Type2	21.14	0	21.14	x	0.17	=	3.58			(29)
Walls Type3	48.08	0	48.08	x	0.8	=	38.46			(29)
Roof Type1	39.87	0	39.87	x	0.15	=	5.98			(30)
Roof Type2	84.96	1.2	83.76	x	0.15	=	12.56			(30)
Total area of elements, m²			375.48							(31)

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DER WorkSheet: New dwelling design stage

Party wall	71.63	x	0	=	0			(32)
Party wall	118.11	x	0	=	0			(32)

** 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) =	190.65	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		56.32	(36)

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

Total fabric heat loss	(33) + (36) =	246.97	(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=	162.79	159.83	156.94	143.34	140.79	128.95	128.95	126.76	133.51	140.79	145.94	151.32	(38)

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

(39)m=	409.76	406.8	403.91	390.31	387.77	375.92	375.92	373.73	380.49	387.77	392.91	398.29	

Average = Sum(39)$_{1\ldots12}$ /12= 390.3 (39)

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

(40)m=	2.32	2.3	2.29	2.21	2.2	2.13	2.13	2.12	2.15	2.2	2.23	2.26	

Average = Sum(40)$_{1\ldots12}$ /12= 2.21 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N	2.97	(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	104.77	(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=	115.24	111.05	106.86	102.67	98.48	94.29	94.29	98.48	102.67	106.86	111.05	115.24	

Total = Sum(44)$_{1\ldots12}$ = 1257.22 (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=	170.9	149.47	154.24	134.47	129.03	111.34	103.18	118.4	119.81	139.63	152.41	165.51	

Total = Sum(45)$_{1\ldots12}$ = 1648.41 (45)

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

(46)m=	25.64	22.42	23.14	20.17	19.35	16.7	15.48	17.76	17.97	20.94	22.86	24.83	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	250	(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:

DER WorkSheet: New dwelling design stage

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) =	250	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.04	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.78	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	4.91	(54)
Enter (50) or (54) in (55)		4.91	(55)

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

(56)m=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	152.26	137.52	152.26	147.35	152.26	147.35	152.26	152.26	147.35	152.26	147.35	152.26	(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=	346.43	308.01	329.77	304.33	304.55	281.2	278.7	293.92	289.67	315.15	322.27	341.03	(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=	346.43	308.01	329.77	304.33	304.55	281.2	278.7	293.92	289.67	315.15	322.27	341.03	

Output from water heater (annual)1…12 — 3715.04 (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=	197.24	176.53	191.7	180.6	183.32	172.91	174.72	179.78	175.73	186.84	186.57	195.45	(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=	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	148.56	(66)

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

(67)m=	31.24	27.75	22.57	17.08	12.77	10.78	11.65	15.14	20.32	25.81	30.12	32.11	(67)

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

(68)m=	348.18	351.8	342.69	323.31	298.84	275.84	260.48	256.87	265.97	285.36	309.82	332.82	(68)

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

(69)m=	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	37.86	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	-118.85	(71)

Water heating gains (Table 5)

(72)m=	265.11	262.69	257.67	250.83	246.4	240.15	234.84	241.65	244.06	251.13	259.12	262.7	(72)

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

(73)m=	712.11	709.81	690.49	658.8	625.58	594.35	574.54	581.23	597.93	629.87	666.63	695.2	(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	1.84	x	10.63	x	0.85	x	0.7	=	16.14	(74)
North	0.9x	0.77	x	1.43	x	10.63	x	0.85	x	0.7	=	18.81	(74)
North	0.9x	0.77	x	1.84	x	20.32	x	0.85	x	0.7	=	30.83	(74)
North	0.9x	0.77	x	1.43	x	20.32	x	0.85	x	0.7	=	35.95	(74)
North	0.9x	0.77	x	1.84	x	34.53	x	0.85	x	0.7	=	52.4	(74)
North	0.9x	0.77	x	1.43	x	34.53	x	0.85	x	0.7	=	61.08	(74)
North	0.9x	0.77	x	1.84	x	55.46	x	0.85	x	0.7	=	84.16	(74)
North	0.9x	0.77	x	1.43	x	55.46	x	0.85	x	0.7	=	98.11	(74)
North	0.9x	0.77	x	1.84	x	74.72	x	0.85	x	0.7	=	113.37	(74)
North	0.9x	0.77	x	1.43	x	74.72	x	0.85	x	0.7	=	132.17	(74)
North	0.9x	0.77	x	1.84	x	79.99	x	0.85	x	0.7	=	121.37	(74)
North	0.9x	0.77	x	1.43	x	79.99	x	0.85	x	0.7	=	141.49	(74)
North	0.9x	0.77	x	1.84	x	74.68	x	0.85	x	0.7	=	113.31	(74)
North	0.9x	0.77	x	1.43	x	74.68	x	0.85	x	0.7	=	132.1	(74)
North	0.9x	0.77	x	1.84	x	59.25	x	0.85	x	0.7	=	89.9	(74)
North	0.9x	0.77	x	1.43	x	59.25	x	0.85	x	0.7	=	104.8	(74)
North	0.9x	0.77	x	1.84	x	41.52	x	0.85	x	0.7	=	63	(74)
North	0.9x	0.77	x	1.43	x	41.52	x	0.85	x	0.7	=	73.44	(74)
North	0.9x	0.77	x	1.84	x	24.19	x	0.85	x	0.7	=	36.7	(74)
North	0.9x	0.77	x	1.43	x	24.19	x	0.85	x	0.7	=	42.79	(74)
North	0.9x	0.77	x	1.84	x	13.12	x	0.85	x	0.7	=	19.9	(74)
North	0.9x	0.77	x	1.43	x	13.12	x	0.85	x	0.7	=	23.2	(74)
North	0.9x	0.77	x	1.84	x	8.86	x	0.85	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.43	x	8.86	x	0.85	x	0.7	=	15.68	(74)
East	0.9x	3	x	1.8	x	19.64	x	0.65	x	0.7	=	33.44	(76)
East	0.9x	2	x	1.43	x	19.64	x	0.85	x	0.7	=	23.16	(76)
East	0.9x	3	x	1.8	x	38.42	x	0.65	x	0.7	=	65.42	(76)
East	0.9x	2	x	1.43	x	38.42	x	0.85	x	0.7	=	45.31	(76)
East	0.9x	3	x	1.8	x	63.27	x	0.65	x	0.7	=	107.74	(76)
East	0.9x	2	x	1.43	x	63.27	x	0.85	x	0.7	=	74.62	(76)

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DER WorkSheet: New dwelling design stage

East	0.9x	3	x	1.8	x	92.28	x	0.65	x	0.7	=	157.13	(76)
East	0.9x	2	x	1.43	x	92.28	x	0.85	x	0.7	=	108.82	(76)
East	0.9x	3	x	1.8	x	113.09	x	0.65	x	0.7	=	192.56	(76)
East	0.9x	2	x	1.43	x	113.09	x	0.85	x	0.7	=	133.37	(76)
East	0.9x	3	x	1.8	x	115.77	x	0.65	x	0.7	=	197.12	(76)
East	0.9x	2	x	1.43	x	115.77	x	0.85	x	0.7	=	136.53	(76)
East	0.9x	3	x	1.8	x	110.22	x	0.65	x	0.7	=	187.67	(76)
East	0.9x	2	x	1.43	x	110.22	x	0.85	x	0.7	=	129.98	(76)
East	0.9x	3	x	1.8	x	94.68	x	0.65	x	0.7	=	161.2	(76)
East	0.9x	2	x	1.43	x	94.68	x	0.85	x	0.7	=	111.65	(76)
East	0.9x	3	x	1.8	x	73.59	x	0.65	x	0.7	=	125.3	(76)
East	0.9x	2	x	1.43	x	73.59	x	0.85	x	0.7	=	86.78	(76)
East	0.9x	3	x	1.8	x	45.59	x	0.65	x	0.7	=	77.62	(76)
East	0.9x	2	x	1.43	x	45.59	x	0.85	x	0.7	=	53.76	(76)
East	0.9x	3	x	1.8	x	24.49	x	0.65	x	0.7	=	41.7	(76)
East	0.9x	2	x	1.43	x	24.49	x	0.85	x	0.7	=	28.88	(76)
East	0.9x	3	x	1.8	x	16.15	x	0.65	x	0.7	=	27.5	(76)
East	0.9x	2	x	1.43	x	16.15	x	0.85	x	0.7	=	19.05	(76)
South	0.9x	0.77	x	1.93	x	46.75	x	0.65	x	0.7	=	56.9	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.65	x	0.7	=	106.14	(78)
South	0.9x	0.77	x	1.43	x	46.75	x	0.85	x	0.7	=	82.7	(78)
South	0.9x	0.77	x	1.93	x	76.57	x	0.65	x	0.7	=	93.19	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.65	x	0.7	=	173.83	(78)
South	0.9x	0.77	x	1.43	x	76.57	x	0.85	x	0.7	=	135.44	(78)
South	0.9x	0.77	x	1.93	x	97.53	x	0.65	x	0.7	=	118.71	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.65	x	0.7	=	221.43	(78)
South	0.9x	0.77	x	1.43	x	97.53	x	0.85	x	0.7	=	172.53	(78)
South	0.9x	0.77	x	1.93	x	110.23	x	0.65	x	0.7	=	134.17	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.65	x	0.7	=	250.26	(78)
South	0.9x	0.77	x	1.43	x	110.23	x	0.85	x	0.7	=	195	(78)
South	0.9x	0.77	x	1.93	x	114.87	x	0.65	x	0.7	=	139.81	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.65	x	0.7	=	260.79	(78)
South	0.9x	0.77	x	1.43	x	114.87	x	0.85	x	0.7	=	203.2	(78)
South	0.9x	0.77	x	1.93	x	110.55	x	0.65	x	0.7	=	134.55	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.65	x	0.7	=	250.97	(78)
South	0.9x	0.77	x	1.43	x	110.55	x	0.85	x	0.7	=	195.55	(78)
South	0.9x	0.77	x	1.93	x	108.01	x	0.65	x	0.7	=	131.46	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.65	x	0.7	=	245.22	(78)
South	0.9x	0.77	x	1.43	x	108.01	x	0.85	x	0.7	=	191.06	(78)
South	0.9x	0.77	x	1.93	x	104.89	x	0.65	x	0.7	=	127.67	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.65	x	0.7	=	238.14	(78)

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DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.43	x	104.89	x	0.85	x	0.7	=	185.55	(78)
South	0.9x	0.77	x	1.93	x	101.89	x	0.65	x	0.7	=	124.01	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.65	x	0.7	=	231.31	(78)
South	0.9x	0.77	x	1.43	x	101.89	x	0.85	x	0.7	=	180.23	(78)
South	0.9x	0.77	x	1.93	x	82.59	x	0.65	x	0.7	=	100.52	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.65	x	0.7	=	187.49	(78)
South	0.9x	0.77	x	1.43	x	82.59	x	0.85	x	0.7	=	146.09	(78)
South	0.9x	0.77	x	1.93	x	55.42	x	0.65	x	0.7	=	67.45	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.65	x	0.7	=	125.81	(78)
South	0.9x	0.77	x	1.43	x	55.42	x	0.85	x	0.7	=	98.03	(78)
South	0.9x	0.77	x	1.93	x	40.4	x	0.65	x	0.7	=	49.17	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.65	x	0.7	=	91.71	(78)
South	0.9x	0.77	x	1.43	x	40.4	x	0.85	x	0.7	=	71.46	(78)
Rooflights	0.9x	1	x	1.2	x	26	x	0.65	x	0.7	=	12.78	(82)
Rooflights	0.9x	1	x	1.2	x	54	x	0.65	x	0.7	=	26.54	(82)
Rooflights	0.9x	1	x	1.2	x	96	x	0.65	x	0.7	=	47.17	(82)
Rooflights	0.9x	1	x	1.2	x	150	x	0.65	x	0.7	=	73.71	(82)
Rooflights	0.9x	1	x	1.2	x	192	x	0.65	x	0.7	=	94.35	(82)
Rooflights	0.9x	1	x	1.2	x	200	x	0.65	x	0.7	=	98.28	(82)
Rooflights	0.9x	1	x	1.2	x	189	x	0.65	x	0.7	=	92.87	(82)
Rooflights	0.9x	1	x	1.2	x	157	x	0.65	x	0.7	=	77.15	(82)
Rooflights	0.9x	1	x	1.2	x	115	x	0.65	x	0.7	=	56.51	(82)
Rooflights	0.9x	1	x	1.2	x	66	x	0.65	x	0.7	=	32.43	(82)
Rooflights	0.9x	1	x	1.2	x	33	x	0.65	x	0.7	=	16.22	(82)
Rooflights	0.9x	1	x	1.2	x	21	x	0.65	x	0.7	=	10.32	(82)

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

(83)m=	350.07	606.51	855.67	1101.36	1269.62	1275.86	1223.67	1096.06	940.57	677.41	421.19	298.34	(83)

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

(84)m=	1062.17	1316.31	1546.16	1760.15	1895.19	1870.21	1798.22	1677.29	1538.5	1307.27	1087.82	993.54	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.93	0.85	0.73	0.77	0.91	0.98	0.99	1	(86)

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

(87)m=	18.46	18.7	19.09	19.66	20.18	20.63	20.84	20.81	20.45	19.77	19.05	18.48	(87)

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

(88)m=	19.13	19.14	19.15	19.2	19.21	19.25	19.25	19.26	19.23	19.21	19.19	19.17	(88)

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

(89)m=	1	0.99	0.98	0.95	0.89	0.73	0.51	0.57	0.84	0.97	0.99	1	(89)

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

DER WorkSheet: New dwelling design stage

(90)m=	15.91	16.25	16.83	17.67	18.4	19	19.2	19.18	18.8	17.85	16.8	15.94	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	16.69	17	17.52	18.28	18.95	19.5	19.7	19.68	19.3	18.44	17.49	16.72	(92)

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

(93)m=	16.69	17	17.52	18.28	18.95	19.5	19.7	19.68	19.3	18.44	17.49	16.72	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.94	0.88	0.75	0.58	0.63	0.84	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1054.4	1298	1504.36	1660.35	1668.95	1411.28	1042.5	1060.12	1299.64	1251.4	1074.18	987.75	(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=	5076.74	4922.01	4452.46	3660.5	2810.2	1841.88	1166.67	1226.59	1980.27	3039.14	4081.37	4986.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2992.62	2435.33	2193.39	1440.11	849.09	0	0	0	0	1330.08	2165.18	2975.25	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 16381.04 (98)

Space heating requirement in kWh/m²/year 92.78 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	3533.68	2781.83	2840.35	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.58	0.66	0.63	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2032.64	1840.74	1776.79	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2268.71	2182.56	2046.2	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	0	254.31	0	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 254.31 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.79 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	50.41	0	0	0	0	0

Total = Sum(107)$_{6...8}$ = 50.41 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.29 (108)

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DER WorkSheet: New dwelling design stage

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		16381.04	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	17200.09	(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		3715.04	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	3900.79	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	211.01	(313)
Cooling System Energy Efficiency Ratio		4.38	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	11.52	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		551.74	(332)

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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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	5008.56	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	109.51	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	5118.08	(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) =				5118.08	(376)

DER WorkSheet: New dwelling design stage

CO2 associated with space cooling	(315) x	0.52	=	5.98	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	286.35	(379)
Total CO2, kg/year	sum of (376)…(382) =			5410.41	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			30.64	(384)
EI rating (section 14)				67.28	(385)

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SAP Input

Property Details: Flat 3

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	28 October 2015
Date of certificate:	30 October 2015
Assessment type:	New dwelling design stage
Transaction type:	None of the above
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	383

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2015

Floor Location:	Floor area:	Storey height:
Floor 0	40.62 m²	3.2 m
Floor 1	110.03 m²	2.65 m

Living area:	69.89 m² (fraction 0.464)
Front of dwelling faces:	Unspecified

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Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D1	Manufacturer	Solid			Wood
W1	Manufacturer	Windows	Single-glazed	No	Wood
W2	Manufacturer	Windows	Single-glazed	No	
W3	Manufacturer	Windows	Single-glazed	No	
W4	Manufacturer	Windows	Single-glazed	No	
w5	Manufacturer	Windows	Single-glazed	No	
RF1	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U
RFl2	Manufacturer	Roof Windows	low-E, En = 0.2, hard coat	No	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D1	mm	0.7	0	2	2.1	1
W1		0.7	0.65	4.5	1.86	3
W2	16mm or more	0.7	0.65	4.5	0.75	4
W3	16mm or more	0.7	0.65	4.5	1.2	2
W4	16mm or more	0.7	0.85	4.5	1.2	2
w5	16mm or more	0.7	0.85	4.5	8.4	1
RF1	16mm or more	0.7	0.65	1.5	2.49	1
RFl2	16mm or more	0.7	0.65	1.5	3.35	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D1		corridor		1	2.1
W1		External wall GF	South	1.161	1.6
W2		External FF	South	1	0.75
W3		External FF	West	1	1.2
W4		External FF	North	1	1.2
w5		External FF	East	4	2.1
RF1		Flat roof 2	Horizontal	1.868	1.331
RFl2		Flat roof 2	Horizontal	1.83	1.83

SAP Input

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External wall GF	26.056	5.58	20.48	0.8	0	False	N/A
corridor GF	21.14	0	21.14	0.2	0.9	False	N/A
External FF	80.03	16.2	63.83	0.8	0	False	N/A
flat roof 1	110.03	0	110.03	0.15	0		N/A
Internal Elements							
Party Elements							
party GF	48.104						N/A
Party wall FF	22.83						N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: No (Assumed)
Ventilation: Natural ventilation (extract fans)
Number of chimneys: 1 (main: 0, secondary: 0, other: 1)
Number of open flues: 0
Number of fans: 4
Number of passive stacks: 0
Number of sides sheltered: 2
Pressure test: 15

Main heating system:

Main heating system: Community heating schemes
Heat source: Community boilers
heat from boilers – mains gas, heat fraction 1, efficiency 91
Piping>=1991, pre-insulated, low temp, variable flow

Main heating Control:

Main heating Control: Charging system linked to use of community heating, programmer and at least two room thermosta
Control code: 2312

Secondary heating system:

Secondary heating system: None

Space cooling system:

Space cooling system: Split/multiple systems
Tested data to EN 14511:
Brand/Model: TBC`
EER: 3.5
Compressor control: Systems with On/Off control
Cooled area: 140 (fraction 0.929)

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :heat from boilers – mains gas
Hot water cylinder
Cylinder volume: 310 litres
Cylinder insulation: Jacket 35 mm
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

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SAP Input

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	40.62	(1a)	x	3.2	(2a)	=	129.98	(3a)
First floor	110.03	(1b)	x	2.65	(2b)	=	291.58	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150.65	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	421.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40	=	40	(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)

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				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.19	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.94	(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) =	0.8	(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

SAP WorkSheet: New dwelling design stage

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

1.02	1	0.98	0.88	0.86	0.76	0.76	0.74	0.8	0.86	0.9	0.94

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=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(24d)

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

(25)m=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(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	2	=	4.2			(26)
Windows Type 1			1.86	x1/[1/(4.5)+ 0.04]		=	7.09			(27)
Windows Type 2			0.75	x1/[1/(4.5)+ 0.04]		=	2.86			(27)
Windows Type 3			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 4			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 5			8.4	x1/[1/(4.5)+ 0.04]		=	32.03			(27)
Rooflights Type 1			2.49	x1/[1/(1.5) + 0.04]		=	3.735			(27b)
Rooflights Type 2			3.35	x1/[1/(1.5) + 0.04]		=	5.025			(27b)
Walls Type1	26.06	5.58	20.48	x	0.8	=	16.38			(29)
Walls Type2	21.14	0	21.14	x	0.17	=	3.58			(29)
Walls Type3	80.03	16.2	63.83	x	0.8	=	51.06			(29)
Roof	110.03	0	110.03	x	0.15	=	16.5			(30)
Total area of elements, m²			245.2							(31)
Party wall			48.1	x	0	=	0			(32)
Party wall			22.83	x	0	=	0			(32)

** 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) = 183.06 (33)

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SAP WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		36.78	(36)

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

Total fabric heat loss	(33) + (36) =	219.84	(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=	141.69	138.91	136.16	123.26	120.85	109.61	109.61	107.53	113.94	120.85	125.73	130.84	(38)

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

(39)m=	361.52	358.74	356	343.1	340.68	329.45	329.45	327.37	333.78	340.68	345.57	350.67	

Average = Sum(39)1…12 /12= 343.08 (39)

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

(40)m=	2.4	2.38	2.36	2.28	2.26	2.19	2.19	2.17	2.22	2.26	2.29	2.33	

Average = Sum(40)1…12 /12= 2.28 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.94 (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 — 103.91 (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=	114.3	110.15	105.99	101.83	97.68	93.52	93.52	97.68	101.83	105.99	110.15	114.3	

Total = Sum(44)1…12 = 1246.93 (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=	169.51	148.25	152.98	133.37	127.98	110.43	102.33	117.43	118.83	138.49	151.17	164.16	

Total = Sum(45)1…12 = 1634.92 (45)

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

(46)m=	25.43	22.24	22.95	20.01	19.2	16.56	15.35	17.61	17.82	20.77	22.68	24.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 310 (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) = 310 (50)

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

SAP WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.04 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.73 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 5.67 (54)

Enter (50) or (54) in (55) 5.67 (55)

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

(56)m=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	368.51	327.99	351.98	325.95	326.98	303.01	301.33	316.43	311.41	337.49	343.75	363.16	(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=	368.51	327.99	351.98	325.95	326.98	303.01	301.33	316.43	311.41	337.49	343.75	363.16	

Output from water heater (annual)$_{1...12}$ 3977.99 (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=	215.56	193.09	210.07	198.41	201.75	190.78	193.23	198.25	193.58	205.25	204.33	213.78	(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=	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	176.11	(66)

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

(67)m=	71.59	63.59	51.71	39.15	29.27	24.71	26.7	34.7	46.58	59.14	69.03	73.58	(67)

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

(68)m=	479.45	484.42	471.88	445.19	411.5	379.84	358.68	353.71	366.24	392.93	426.63	458.29	(68)

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

(69)m=	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	55.55	(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=	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	(71)

Water heating gains (Table 5)

(72)m=	289.73	287.33	282.35	275.57	271.17	264.98	259.71	266.46	268.86	275.87	283.79	287.34	(72)

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SAP WorkSheet: New dwelling design stage

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

(73)m=	955.02	949.59	920.2	874.17	826.19	783.77	759.34	769.12	795.93	842.19	893.69	933.47	(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 1	x	1.2	x	10.63	x	0.85	x	0.7	=	13.67	(74)
North	0.9x 1	x	1.2	x	20.32	x	0.85	x	0.7	=	26.12	(74)
North	0.9x 1	x	1.2	x	34.53	x	0.85	x	0.7	=	44.38	(74)
North	0.9x 1	x	1.2	x	55.46	x	0.85	x	0.7	=	71.28	(74)
North	0.9x 1	x	1.2	x	74.72	x	0.85	x	0.7	=	96.02	(74)
North	0.9x 1	x	1.2	x	79.99	x	0.85	x	0.7	=	102.8	(74)
North	0.9x 1	x	1.2	x	74.68	x	0.85	x	0.7	=	95.97	(74)
North	0.9x 1	x	1.2	x	59.25	x	0.85	x	0.7	=	76.14	(74)
North	0.9x 1	x	1.2	x	41.52	x	0.85	x	0.7	=	53.36	(74)
North	0.9x 1	x	1.2	x	24.19	x	0.85	x	0.7	=	31.09	(74)
North	0.9x 1	x	1.2	x	13.12	x	0.85	x	0.7	=	16.86	(74)
North	0.9x 1	x	1.2	x	8.86	x	0.85	x	0.7	=	11.39	(74)
East	0.9x 1	x	8.4	x	19.64	x	0.85	x	0.7	=	88.35	(76)
East	0.9x 1	x	8.4	x	38.42	x	0.85	x	0.7	=	172.82	(76)
East	0.9x 1	x	8.4	x	63.27	x	0.85	x	0.7	=	284.62	(76)
East	0.9x 1	x	8.4	x	92.28	x	0.85	x	0.7	=	415.09	(76)
East	0.9x 1	x	8.4	x	113.09	x	0.85	x	0.7	=	508.71	(76)
East	0.9x 1	x	8.4	x	115.77	x	0.85	x	0.7	=	520.76	(76)
East	0.9x 1	x	8.4	x	110.22	x	0.85	x	0.7	=	495.78	(76)
East	0.9x 1	x	8.4	x	94.68	x	0.85	x	0.7	=	425.87	(76)
East	0.9x 1	x	8.4	x	73.59	x	0.85	x	0.7	=	331.02	(76)
East	0.9x 1	x	8.4	x	45.59	x	0.85	x	0.7	=	205.07	(76)
East	0.9x 1	x	8.4	x	24.49	x	0.85	x	0.7	=	110.16	(76)
East	0.9x 1	x	8.4	x	16.15	x	0.85	x	0.7	=	72.65	(76)
South	0.9x 1	x	1.86	x	46.75	x	0.65	x	0.7	=	106.83	(78)
South	0.9x 1	x	0.75	x	46.75	x	0.65	x	0.7	=	57.43	(78)
South	0.9x 1	x	1.86	x	76.57	x	0.65	x	0.7	=	174.96	(78)
South	0.9x 1	x	0.75	x	76.57	x	0.65	x	0.7	=	94.06	(78)
South	0.9x 1	x	1.86	x	97.53	x	0.65	x	0.7	=	222.87	(78)
South	0.9x 1	x	0.75	x	97.53	x	0.65	x	0.7	=	119.82	(78)
South	0.9x 1	x	1.86	x	110.23	x	0.65	x	0.7	=	251.89	(78)
South	0.9x 1	x	0.75	x	110.23	x	0.65	x	0.7	=	135.42	(78)
South	0.9x 1	x	1.86	x	114.87	x	0.65	x	0.7	=	262.48	(78)
South	0.9x 1	x	0.75	x	114.87	x	0.65	x	0.7	=	141.12	(78)

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SAP WorkSheet: New dwelling design stage

South	0.9x	1	x	1.86	x	110.55	x	0.65	x	0.7	=	252.6	(78)
South	0.9x	1	x	0.75	x	110.55	x	0.65	x	0.7	=	135.81	(78)
South	0.9x	1	x	1.86	x	108.01	x	0.65	x	0.7	=	246.81	(78)
South	0.9x	1	x	0.75	x	108.01	x	0.65	x	0.7	=	132.69	(78)
South	0.9x	1	x	1.86	x	104.89	x	0.65	x	0.7	=	239.69	(78)
South	0.9x	1	x	0.75	x	104.89	x	0.65	x	0.7	=	128.86	(78)
South	0.9x	1	x	1.86	x	101.89	x	0.65	x	0.7	=	232.81	(78)
South	0.9x	1	x	0.75	x	101.89	x	0.65	x	0.7	=	125.17	(78)
South	0.9x	1	x	1.86	x	82.59	x	0.65	x	0.7	=	188.71	(78)
South	0.9x	1	x	0.75	x	82.59	x	0.65	x	0.7	=	101.46	(78)
South	0.9x	1	x	1.86	x	55.42	x	0.65	x	0.7	=	126.63	(78)
South	0.9x	1	x	0.75	x	55.42	x	0.65	x	0.7	=	68.08	(78)
South	0.9x	1	x	1.86	x	40.4	x	0.65	x	0.7	=	92.31	(78)
South	0.9x	1	x	0.75	x	40.4	x	0.65	x	0.7	=	49.63	(78)
West	0.9x	1	x	1.2	x	19.64	x	0.65	x	0.7	=	19.3	(80)
West	0.9x	1	x	1.2	x	38.42	x	0.65	x	0.7	=	37.76	(80)
West	0.9x	1	x	1.2	x	63.27	x	0.65	x	0.7	=	62.18	(80)
West	0.9x	1	x	1.2	x	92.28	x	0.65	x	0.7	=	90.69	(80)
West	0.9x	1	x	1.2	x	113.09	x	0.65	x	0.7	=	111.15	(80)
West	0.9x	1	x	1.2	x	115.77	x	0.65	x	0.7	=	113.78	(80)
West	0.9x	1	x	1.2	x	110.22	x	0.65	x	0.7	=	108.32	(80)
West	0.9x	1	x	1.2	x	94.68	x	0.65	x	0.7	=	93.05	(80)
West	0.9x	1	x	1.2	x	73.59	x	0.65	x	0.7	=	72.32	(80)
West	0.9x	1	x	1.2	x	45.59	x	0.65	x	0.7	=	44.81	(80)
West	0.9x	1	x	1.2	x	24.49	x	0.65	x	0.7	=	24.07	(80)
West	0.9x	1	x	1.2	x	16.15	x	0.65	x	0.7	=	15.87	(80)
Rooflights	0.9x	1	x	2.49	x	26	x	0.65	x	0.7	=	26.51	(82)
Rooflights	0.9x	1	x	3.35	x	26	x	0.65	x	0.7	=	35.67	(82)
Rooflights	0.9x	1	x	2.49	x	54	x	0.65	x	0.7	=	55.06	(82)
Rooflights	0.9x	1	x	3.35	x	54	x	0.65	x	0.7	=	74.08	(82)
Rooflights	0.9x	1	x	2.49	x	96	x	0.65	x	0.7	=	97.89	(82)
Rooflights	0.9x	1	x	3.35	x	96	x	0.65	x	0.7	=	131.7	(82)
Rooflights	0.9x	1	x	2.49	x	150	x	0.65	x	0.7	=	152.95	(82)
Rooflights	0.9x	1	x	3.35	x	150	x	0.65	x	0.7	=	205.77	(82)
Rooflights	0.9x	1	x	2.49	x	192	x	0.65	x	0.7	=	195.77	(82)
Rooflights	0.9x	1	x	3.35	x	192	x	0.65	x	0.7	=	263.39	(82)
Rooflights	0.9x	1	x	2.49	x	200	x	0.65	x	0.7	=	203.93	(82)
Rooflights	0.9x	1	x	3.35	x	200	x	0.65	x	0.7	=	274.36	(82)
Rooflights	0.9x	1	x	2.49	x	189	x	0.65	x	0.7	=	192.71	(82)
Rooflights	0.9x	1	x	3.35	x	189	x	0.65	x	0.7	=	259.27	(82)
Rooflights	0.9x	1	x	2.49	x	157	x	0.65	x	0.7	=	160.09	(82)

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SAP WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	3.35	x	157	x	0.65	x	0.7	=	215.38	(82)
Rooflights 0.9x	1	x	2.49	x	115	x	0.65	x	0.7	=	117.26	(82)
Rooflights 0.9x	1	x	3.35	x	115	x	0.65	x	0.7	=	157.76	(82)
Rooflights 0.9x	1	x	2.49	x	66	x	0.65	x	0.7	=	67.3	(82)
Rooflights 0.9x	1	x	3.35	x	66	x	0.65	x	0.7	=	90.54	(82)
Rooflights 0.9x	1	x	2.49	x	33	x	0.65	x	0.7	=	33.65	(82)
Rooflights 0.9x	1	x	3.35	x	33	x	0.65	x	0.7	=	45.27	(82)
Rooflights 0.9x	1	x	2.49	x	21	x	0.65	x	0.7	=	21.41	(82)
Rooflights 0.9x	1	x	3.35	x	21	x	0.65	x	0.7	=	28.81	(82)

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

(83)m=	347.76	634.86	963.45	1323.1	1578.65	1604.04	1531.57	1339.07	1089.7	728.97	424.71	292.08	(83)

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

(84)m=	1302.78	1584.45	1883.64	2197.27	2404.84	2387.81	2290.91	2108.19	1885.62	1571.16	1318.4	1225.55	(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	0.98	0.97	0.93	0.85	0.71	0.57	0.62	0.83	0.95	0.99	0.99	(86)

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

(87)m=	18.59	18.85	19.29	19.91	20.41	20.78	20.92	20.89	20.61	19.94	19.19	18.6	(87)

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

(88)m=	19.08	19.09	19.1	19.15	19.16	19.21	19.21	19.22	19.19	19.16	19.14	19.12	(88)

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

(89)m=	0.99	0.98	0.95	0.89	0.77	0.57	0.36	0.42	0.72	0.92	0.98	0.99	(89)

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

(90)m=	16.06	16.45	17.09	17.98	18.65	19.09	19.19	19.19	18.92	18.05	16.97	16.1	(90)

fLA = Living area ÷ (4) = 0.46 (91)

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

(92)m=	17.24	17.56	18.11	18.87	19.47	19.87	19.99	19.98	19.71	18.93	18	17.26	(92)

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

(93)m=	17.24	17.56	18.11	18.87	19.47	19.87	19.99	19.98	19.71	18.93	18	17.26	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.94	0.89	0.79	0.63	0.46	0.51	0.75	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1280.39	1537.29	1778.83	1950.7	1893.97	1496.84	1053.59	1081.27	1419.09	1443.67	1281.84	1208	(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=	4676.41	4543.28	4134.32	3421.34	2645.44	1737.49	1118.16	1172.18	1871.28	2836.74	3767.77	4580.06	(97)

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SAP WorkSheet: New dwelling design stage

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

(98)m=	2526.64	2020.02	1752.49	1058.86	559.09	0	0	0	0	1036.44	1789.87	2508.81

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 13252.22 (98)

Space heating requirement in kWh/m²/year 87.97 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	3096.83	2437.93	2488.01	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.65	0.73	0.69	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2017.89	1787.17	1721.5	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2387.81	2290.91	2108.19	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	0	374.79	287.7	0	0	0	0

Total = Sum(104)$_{6...8}$ = 662.48 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.93 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	87.07	66.84	0	0	0	0

Total = Sum(107)$_{6...8}$ = 153.91 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.02 (108)

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		13252.22	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	13914.83	(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)

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SAP WorkSheet: New dwelling design stage

Water heating

Annual water heating requirement		3977.99	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	4176.89	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	180.92	(313)
Cooling System Energy Efficiency Ratio		4.38	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	35.18	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		505.75	(332)

10b. Fuel costs – Community heating scheme

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	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	4.24	x 0.01 =	589.99	(340a)
Water heating from CHP	(310a)	x	4.24	x 0.01 =	177.1	(342a)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	4.64	(348)
Pumps and fans	(331)		13.19	x 0.01 =	0	(349)
Energy for lighting	(332)		13.19	x 0.01 =	66.71	(350)
Additional standing charges (Table 12)					120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =				958.44	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	2.06	(357)
SAP rating (section12)		71.3	(358)

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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	4294.3	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	93.9	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	4388.2	(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)

SAP WorkSheet: New dwelling design stage

Total CO2 associated with space and water heating	(373) + (374) + (375) =				4388.2	(376)
CO2 associated with space cooling	(315) x		0.52	=	18.26	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	262.49	(379)
Total CO2, kg/year	sum of (376)…(382) =				4668.94	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				30.99	(384)
EI rating (section 14)					68.02	(385)

13b. Primary Energy – Community heating scheme

		Energy kWh/year	Primary factor		P.Energy kWh/year	
Energy 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				91	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	24254.84	(367)
Electrical energy for heat distribution	[(313) x			=	555.42	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	24810.26	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					24810.26	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				24810.26	(376)
Energy associated with space cooling	(315) x		3.07	=	108	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	0	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	1552.66	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =				26470.92	(383)

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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.1.24

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	40.62	(1a)	x	3.2	(2a)	=	129.98	(3a)
First floor	110.03	(1b)	x	2.65	(2b)	=	291.58	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150.65	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	421.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	1	=	1	x 40 =	40	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	80	÷ (5) =	0.19	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.94	(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) =	0.8	(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

DER WorkSheet: New dwelling design stage

DRAFT

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

1.02	1	0.98	0.88	0.86	0.76	0.76	0.74	0.8	0.86	0.9	0.94

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=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(24d)

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

(25)m=	1.02	1	0.98	0.89	0.87	0.79	0.79	0.77	0.82	0.87	0.9	0.94	(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	2	=	4.2			(26)
Windows Type 1			1.86	x1/[1/(4.5)+ 0.04]		=	7.09			(27)
Windows Type 2			0.75	x1/[1/(4.5)+ 0.04]		=	2.86			(27)
Windows Type 3			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 4			1.2	x1/[1/(4.5)+ 0.04]		=	4.58			(27)
Windows Type 5			8.4	x1/[1/(4.5)+ 0.04]		=	32.03			(27)
Rooflights Type 1			2.49	x1/[1/(1.5) + 0.04]		=	3.735			(27b)
Rooflights Type 2			3.35	x1/[1/(1.5) + 0.04]		=	5.025			(27b)
Walls Type1	26.06	5.58	20.48	x	0.8	=	16.38			(29)
Walls Type2	21.14	0	21.14	x	0.17	=	3.58			(29)
Walls Type3	80.03	16.2	63.83	x	0.8	=	51.06			(29)
Roof	110.03	0	110.03	x	0.15	=	16.5			(30)
Total area of elements, m²			245.2							(31)
Party wall			48.1	x	0	=	0			(32)
Party wall			22.83	x	0	=	0			(32)

** 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) = 183.06 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		36.78	(36)

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

Total fabric heat loss	(33) + (36) =	219.84	(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=	141.69	138.91	136.16	123.26	120.85	109.61	109.61	107.53	113.94	120.85	125.73	130.84	(38)

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

(39)m=	361.52	358.74	356	343.1	340.68	329.45	329.45	327.37	333.78	340.68	345.57	350.67	

Average = Sum(39)$_{1…12}$ /12= 343.08 (39)

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

(40)m=	2.4	2.38	2.36	2.28	2.26	2.19	2.19	2.17	2.22	2.26	2.29	2.33	

Average = Sum(40)$_{1…12}$ /12= 2.28 (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)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N	2.94	(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	103.91	(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=	114.3	110.15	105.99	101.83	97.68	93.52	93.52	97.68	101.83	105.99	110.15	114.3	

Total = Sum(44)$_{1…12}$ = 1246.93 (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=	169.51	148.25	152.98	133.37	127.98	110.43	102.33	117.43	118.83	138.49	151.17	164.16	

Total = Sum(45)$_{1…12}$ = 1634.92 (45)

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

(46)m=	25.43	22.24	22.95	20.01	19.2	16.56	15.35	17.61	17.82	20.77	22.68	24.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		310	(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) =	310	(50)

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

DER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)		0.04	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.73	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	5.67	(54)
Enter (50) or (54) in (55)		5.67	(55)

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

(56)m=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	175.74	158.73	175.74	170.07	175.74	170.07	175.74	175.74	170.07	175.74	170.07	175.74	(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=	368.51	327.99	351.98	325.95	326.98	303.01	301.33	316.43	311.41	337.49	343.75	363.16	(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=	368.51	327.99	351.98	325.95	326.98	303.01	301.33	316.43	311.41	337.49	343.75	363.16	

Output from water heater (annual)$_{1…12}$ | 3977.99 | (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=	215.56	193.09	210.07	198.41	201.75	190.78	193.23	198.25	193.58	205.25	204.33	213.78	(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=	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	146.76	(66)

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

(67)m=	28.72	25.51	20.75	15.71	11.74	9.91	10.71	13.92	18.69	23.73	27.69	29.52	(67)

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

(68)m=	321.23	324.56	316.16	298.28	275.71	254.49	240.32	236.98	245.38	263.27	285.84	307.06	(68)

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

(69)m=	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	37.68	(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=	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	-117.41	(71)

Water heating gains (Table 5)

(72)m=	289.73	287.33	282.35	275.57	271.17	264.98	259.71	266.46	268.86	275.87	283.79	287.34	(72)

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DER WorkSheet: New dwelling design stage

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

(73)m=	706.71	704.43	686.29	656.59	625.65	596.41	577.77	584.39	599.95	629.89	664.35	690.95	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.2	x	10.63	x	0.85	x	0.7	=	10.52	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.85	x	0.7	=	20.11	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.85	x	0.7	=	34.17	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.85	x	0.7	=	54.89	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.85	x	0.7	=	73.94	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.85	x	0.7	=	79.15	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.85	x	0.7	=	73.9	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.85	x	0.7	=	58.63	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.85	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.85	x	0.7	=	23.94	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.85	x	0.7	=	12.98	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.85	x	0.7	=	8.77	(74)
East	0.9x	1	x	8.4	x	19.64	x	0.85	x	0.7	=	68.03	(76)
East	0.9x	1	x	8.4	x	38.42	x	0.85	x	0.7	=	133.07	(76)
East	0.9x	1	x	8.4	x	63.27	x	0.85	x	0.7	=	219.15	(76)
East	0.9x	1	x	8.4	x	92.28	x	0.85	x	0.7	=	319.62	(76)
East	0.9x	1	x	8.4	x	113.09	x	0.85	x	0.7	=	391.71	(76)
East	0.9x	1	x	8.4	x	115.77	x	0.85	x	0.7	=	400.98	(76)
East	0.9x	1	x	8.4	x	110.22	x	0.85	x	0.7	=	381.75	(76)
East	0.9x	1	x	8.4	x	94.68	x	0.85	x	0.7	=	327.92	(76)
East	0.9x	1	x	8.4	x	73.59	x	0.85	x	0.7	=	254.88	(76)
East	0.9x	1	x	8.4	x	45.59	x	0.85	x	0.7	=	157.9	(76)
East	0.9x	1	x	8.4	x	24.49	x	0.85	x	0.7	=	84.82	(76)
East	0.9x	1	x	8.4	x	16.15	x	0.85	x	0.7	=	55.94	(76)
South	0.9x	0.77	x	1.86	x	46.75	x	0.65	x	0.7	=	82.26	(78)
South	0.9x	0.77	x	0.75	x	46.75	x	0.65	x	0.7	=	44.22	(78)
South	0.9x	0.77	x	1.86	x	76.57	x	0.65	x	0.7	=	134.72	(78)
South	0.9x	0.77	x	0.75	x	76.57	x	0.65	x	0.7	=	72.43	(78)
South	0.9x	0.77	x	1.86	x	97.53	x	0.65	x	0.7	=	171.61	(78)
South	0.9x	0.77	x	0.75	x	97.53	x	0.65	x	0.7	=	92.26	(78)
South	0.9x	0.77	x	1.86	x	110.23	x	0.65	x	0.7	=	193.95	(78)
South	0.9x	0.77	x	0.75	x	110.23	x	0.65	x	0.7	=	104.28	(78)
South	0.9x	0.77	x	1.86	x	114.87	x	0.65	x	0.7	=	202.11	(78)
South	0.9x	0.77	x	0.75	x	114.87	x	0.65	x	0.7	=	108.66	(78)

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DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.86	x	110.55	x	0.65	x	0.7	=	194.5	(78)
South	0.9x	0.77	x	0.75	x	110.55	x	0.65	x	0.7	=	104.57	(78)
South	0.9x	0.77	x	1.86	x	108.01	x	0.65	x	0.7	=	190.04	(78)
South	0.9x	0.77	x	0.75	x	108.01	x	0.65	x	0.7	=	102.17	(78)
South	0.9x	0.77	x	1.86	x	104.89	x	0.65	x	0.7	=	184.56	(78)
South	0.9x	0.77	x	0.75	x	104.89	x	0.65	x	0.7	=	99.22	(78)
South	0.9x	0.77	x	1.86	x	101.89	x	0.65	x	0.7	=	179.26	(78)
South	0.9x	0.77	x	0.75	x	101.89	x	0.65	x	0.7	=	96.38	(78)
South	0.9x	0.77	x	1.86	x	82.59	x	0.65	x	0.7	=	145.31	(78)
South	0.9x	0.77	x	0.75	x	82.59	x	0.65	x	0.7	=	78.12	(78)
South	0.9x	0.77	x	1.86	x	55.42	x	0.65	x	0.7	=	97.5	(78)
South	0.9x	0.77	x	0.75	x	55.42	x	0.65	x	0.7	=	52.42	(78)
South	0.9x	0.77	x	1.86	x	40.4	x	0.65	x	0.7	=	71.08	(78)
South	0.9x	0.77	x	0.75	x	40.4	x	0.65	x	0.7	=	38.21	(78)
West	0.9x	0.77	x	1.2	x	19.64	x	0.65	x	0.7	=	14.86	(80)
West	0.9x	0.77	x	1.2	x	38.42	x	0.65	x	0.7	=	29.07	(80)
West	0.9x	0.77	x	1.2	x	63.27	x	0.65	x	0.7	=	47.88	(80)
West	0.9x	0.77	x	1.2	x	92.28	x	0.65	x	0.7	=	69.83	(80)
West	0.9x	0.77	x	1.2	x	113.09	x	0.65	x	0.7	=	85.58	(80)
West	0.9x	0.77	x	1.2	x	115.77	x	0.65	x	0.7	=	87.61	(80)
West	0.9x	0.77	x	1.2	x	110.22	x	0.65	x	0.7	=	83.41	(80)
West	0.9x	0.77	x	1.2	x	94.68	x	0.65	x	0.7	=	71.65	(80)
West	0.9x	0.77	x	1.2	x	73.59	x	0.65	x	0.7	=	55.69	(80)
West	0.9x	0.77	x	1.2	x	45.59	x	0.65	x	0.7	=	34.5	(80)
West	0.9x	0.77	x	1.2	x	24.49	x	0.65	x	0.7	=	18.53	(80)
West	0.9x	0.77	x	1.2	x	16.15	x	0.65	x	0.7	=	12.22	(80)
Rooflights	0.9x	1	x	2.49	x	26	x	0.65	x	0.7	=	26.51	(82)
Rooflights	0.9x	1	x	3.35	x	26	x	0.65	x	0.7	=	35.67	(82)
Rooflights	0.9x	1	x	2.49	x	54	x	0.65	x	0.7	=	55.06	(82)
Rooflights	0.9x	1	x	3.35	x	54	x	0.65	x	0.7	=	74.08	(82)
Rooflights	0.9x	1	x	2.49	x	96	x	0.65	x	0.7	=	97.89	(82)
Rooflights	0.9x	1	x	3.35	x	96	x	0.65	x	0.7	=	131.7	(82)
Rooflights	0.9x	1	x	2.49	x	150	x	0.65	x	0.7	=	152.95	(82)
Rooflights	0.9x	1	x	3.35	x	150	x	0.65	x	0.7	=	205.77	(82)
Rooflights	0.9x	1	x	2.49	x	192	x	0.65	x	0.7	=	195.77	(82)
Rooflights	0.9x	1	x	3.35	x	192	x	0.65	x	0.7	=	263.39	(82)
Rooflights	0.9x	1	x	2.49	x	200	x	0.65	x	0.7	=	203.93	(82)
Rooflights	0.9x	1	x	3.35	x	200	x	0.65	x	0.7	=	274.36	(82)
Rooflights	0.9x	1	x	2.49	x	189	x	0.65	x	0.7	=	192.71	(82)
Rooflights	0.9x	1	x	3.35	x	189	x	0.65	x	0.7	=	259.27	(82)
Rooflights	0.9x	1	x	2.49	x	157	x	0.65	x	0.7	=	160.09	(82)

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Rooflights 0.9x	1	x	3.35	x	157	x	0.65	x	0.7	=	215.38	(82)
Rooflights 0.9x	1	x	2.49	x	115	x	0.65	x	0.7	=	117.26	(82)
Rooflights 0.9x	1	x	3.35	x	115	x	0.65	x	0.7	=	157.76	(82)
Rooflights 0.9x	1	x	2.49	x	66	x	0.65	x	0.7	=	67.3	(82)
Rooflights 0.9x	1	x	3.35	x	66	x	0.65	x	0.7	=	90.54	(82)
Rooflights 0.9x	1	x	2.49	x	33	x	0.65	x	0.7	=	33.65	(82)
Rooflights 0.9x	1	x	3.35	x	33	x	0.65	x	0.7	=	45.27	(82)
Rooflights 0.9x	1	x	2.49	x	21	x	0.65	x	0.7	=	21.41	(82)
Rooflights 0.9x	1	x	3.35	x	21	x	0.65	x	0.7	=	28.81	(82)

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

(83)m=	282.07	518.55	794.66	1101.29	1321.17	1345.12	1283.27	1117.44	902.32	597.61	345.18	236.45	(83)

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

(84)m=	988.79	1222.98	1480.94	1757.88	1946.82	1941.53	1861.04	1701.83	1502.27	1227.5	1009.53	927.4	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.96	0.9	0.79	0.66	0.71	0.89	0.97	0.99	1	(86)

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

(87)m=	18.43	18.68	19.11	19.72	20.26	20.7	20.88	20.84	20.49	19.78	19.04	18.45	(87)

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

(88)m=	19.08	19.09	19.1	19.15	19.16	19.21	19.21	19.22	19.19	19.16	19.14	19.12	(88)

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

(89)m=	0.99	0.99	0.97	0.94	0.84	0.66	0.44	0.5	0.8	0.96	0.99	1	(89)

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

(90)m=	15.84	16.2	16.83	17.73	18.48	19.03	19.18	19.17	18.81	17.84	16.75	15.88	(90)

fLA = Living area ÷ (4) = 0.46 (91)

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

(92)m=	17.04	17.35	17.88	18.66	19.31	19.8	19.97	19.95	19.59	18.74	17.81	17.07	(92)

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

(93)m=	17.04	17.35	17.88	18.66	19.31	19.8	19.97	19.95	19.59	18.74	17.81	17.07	(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=	0.99	0.98	0.97	0.93	0.85	0.71	0.54	0.6	0.82	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	980.2	1203.25	1432.26	1630	1651.49	1374.4	1008.07	1020.42	1239.08	1168.25	994.91	920.89	(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=	4606.48	4465.21	4052.83	3347.5	2591.76	1713.35	1109.48	1160.67	1833.26	2773.87	3702.47	4514.64	(97)

DER WorkSheet: New dwelling design stage

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

(98)m=	2697.95	2192.04	1949.7	1236.6	699.56	0	0	0	0	1194.58	1949.44	2673.75

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 14593.62 (98)

Space heating requirement in kWh/m²/year 96.87 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	3096.83	2437.93	2488.01	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.63	0.71	0.67	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1954.12	1740.23	1672.92	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	2275.31	2183.03	2011.93	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	0	329.45	252.23	0	0	0	0

Total = Sum(104)$_{6...8}$ = 581.68 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.93 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	76.54	58.6	0	0	0	0

Total = Sum(107)$_{6...8}$ = 135.14 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.9 (108)

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 14593.62

Space heat from Community boilers (98) x (304a) x (305) x (306) = 15323.31 (307a)

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

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

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DER WorkSheet: New dwelling design stage

Water heating

Annual water heating requirement		3977.99	
If DHW from community scheme:			
Water heat from Community boilers	(64) x (303a) x (305) x (306) =	4176.89	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	195	(313)
Cooling System Energy Efficiency Ratio		4.38	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	30.89	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		507.25	(332)

12b. CO_2 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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	4628.62	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	101.21	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	4729.83	(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) =				4729.83	(376)
CO2 associated with space cooling	(315) x		0.52	=	16.03	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	263.26	(379)

Total CO2, kg/year	sum of (376)…(382) =	5009.12	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	33.25	(384)
EI rating (section 14)		65.69	(385)

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Appendix C - Renewable Technologies; Description, Benefits and Limitations

Domestic Solar Hot Water Heating

Solar thermal or solar hot water (SHW) systems use a collector which is generally mounted on the roof, and typically contains a water glycol mixture which is heated by the sun. The heated liquid is then passed through a coil in a hot water storage cylinder. The water in the cylinder is then further heated (if required) by a boiler or electric immersion heater. The free energy obtained from the sun can be used to offset the amount of energy required for providing domestic hot water, and will reduce both running costs (due to the fuel being displaced electricity, natural gas, Liquefied Petroleum Gas (LPG) or oil) and the associated CO_2 emissions.

These systems are not good enough to provide space heating in the UK due to the climate but are among the most cost-effective renewable energy systems that can be installed to assist with domestic hot water demand.

Solar water heating could be installed by utilising either evacuated tube type panels or flat plate collectors mounted on the roof of the building.

Reasons for Excluding this Technology for this Site

SHW only contributes to the water heating demand of the property and has reduced effectiveness during the winter months. Consequently they do not supply sufficient carbon reduction. This technology is not considered suitable for this project and is not investigated further.

The technology cannot produce a material contribution to the energy needs of a commercial development such as this, as the demand for hot water is for occasional hand washing which represents a very small proportion of the total demand. It is quite possible that the energy consumed by the solar circuit pump would be greater than the energy used by instantaneous water heaters to provide the same amount of hot water. For these reasons solar thermal panels are only suitable for specific commercial applications which have a quantifiable demand for hot water that can be matched to the output characteristic of a solar thermal system.

Photovoltaic Panels (PV)

PV systems convert energy from the sun into electricity through semi-conductor cells. A cell consists of two thin layers of different semi-conducting materials, usually based on silicon. When light shines on the cell, a difference in energy is created – otherwise known as voltage. This voltage is used to produce a direct current (DC), which can be used directly or converted into alternating current (AC). AC can be exported to the local electricity network/national grid. The brighter the sunlight, the more power is produced. Shading from other objects (such as nearby buildings and trees) will affect performance and PV cells are more likely to show a drop in output than solar thermal panels. As with solar hot water, the panels should face as close to due south as possible and be unshaded for most of the day. An individual PV cell only produces a small amount of power, therefore they are usually connected together to form a module. Modules can then be linked to form an array and sized to meet the required demand.

The size of a photovoltaic (PV) installation is expressed by its kilowatt peak (kWp) potential, which is an indication of how much electricity the system could generate at peak/optimum conditions. The electricity generated on-site by photovoltaic cells would be a direct saving on electricity otherwise sourced from the national grid. The electricity generated would be a direct saving on electricity required for power, lighting, heating and hot water (depending on systems installed). Whilst expensive it should be noted that PV technology off-sets 3 times the carbon dioxide from grid supplied electricity compared to technology which reduces natural gas consumption therefore as a single simplistic solution it compares favourably.

Reasons for Excluding this Technology for this Site

The dwellings will be required to be fitted with a PV array and this would have significant visual impact. The proposed development is located within a conservation. Therefore it is not considered appropriate to include such technology.

Air Source Heat Pump

A heat pump extracts heat from the ground, air or water and transfers it to a heating system. Often coupled to underfloor heating, as the temperatures involved are usually lower (around 40 degrees where a boiler will be 80 degrees), an electric pump circulates the water in the system. Ground source heat pumps (GSHP) and air source heat pumps (ASHP) are currently the most common type of heat pump used in the UK, and use technology which is essentially the same as a fridge. A typical GSHP system will include a ground heat exchanger (for extracting heat from the ground), the heat pump itself and a heating system.

The overall efficiency of a heat pump is determined by the difference in temperature between the heat source itself (the ground, air or water) and the temperature of the area or environment to be heated. The smaller the temperature difference the higher the coefficient of performance (COP) will be.

Typical COPs will be in the range 2 – 4 depending upon operating conditions. Heat pumps can supply 100 per cent of heat demand, but it will usually only pre-heat domestic hot water, so an additional method of heating the hot water (e.g. an immersion heater) may be needed. GSHP systems will have a higher capital cost due to the groundworks involved in laying the required pipework which can be quite extensive. An ASHP will be cheaper as the external unit is usually pre- packaged and only requires mounting in position.

Reasons for Excluding this Technology for This Site

Air Source Heat Pumps can be connected in series and thus provide heating and cooling system, modules only work as and when demand requires thus providing excellent efficiencies. The use of this technology will adversely affect the setting of the conservation.

For these reasons heat pumps are deemed not suitable for this project and have not been considered further.

Biomass Boilers

Biomass heating is the combustion of a biomass fuel such as wood in a boiler to supply space heating and hot water. Biomass fuel is biological in origin and, when from sustainable sources, is regarded as renewable.

The most common fuel is wood, supplied in three forms; logs, chips and compressed wood pellets.

Any biomass heating system requires the following main components:

- Fuel storage;
- One or more boilers;
- One or more heat accumulators;
- A chimney stack or flue;
- A heat meter.

Sufficient fuel must be stored on-site to maintain operations in between deliveries. The amount will depend on circumstances, but is typically not less than a week of operation at full load.

The store must keep the fuel dry. Wet fuel will cause the boiler to malfunction.

The design of the store will depend on the fuel selected; logs can be kept in a simple shed, chips in a storage bay and pellets in an enclosed hopper. Typical solutions are silos similar to animal feed storage or partitioned sections in an enclosed barn, outhouse or commodity store.

Access is needed for deliveries and some is needed to convey the fuel to the boiler on demand.

There are two main types of boiler – continuously fuelled and batch fuelled. Continuously fuelled boilers use wood chip or pellet fuels and can be made fully automatic.

The space requirement for biomass plant, equipment and associated fuel storage is significant and given the footprint of the building and its central London location the site has limited off-street loading and delivery areas. Biomass requires frequent and regular deliveries of fuel which would impact on local transportation due to site servicing constraints and would therefore not be suitable for this redevelopment.

Reasons for Excluding this Technology for this Site

There are many discussions at this time with regards to the suitability of biomass within the GLA region due to the Clean Air Act Requirements and the viability of clean biomass systems has not yet been proven.

Therefore the inclusion of biomass has not been deemed appropriate and is not considered further.

Storage limitations dictate whether it is physically feasible to include within the development's renewable energy strategy; a large dry space for storing the fuel would be required to hold several months' worth of fuel. In addition, a fuel supplier would need to be within reasonable vicinity; otherwise the emissions associated with delivery will significantly reduce the onsite carbon savings.

Biomass boilers do not operate in the same way as gas and oil boilers. They have a more limited operating range and cannot respond as rapidly to changes in demand. Short operating cycles are not recommended. The use of a hot water tank or accumulator in the system to balance the output of the boiler and the demand of the heating system is highly recommended. The necessary volume depends on the type of boiler and the character of the heating system. Pellet boilers have a good operating range and a relatively small tank would be used. Log boilers have little range and a large tank that can absorb the energy contained within one or more charges of wood is necessary.

Biomass boilers are combustion appliances and are subject to regulation on placing height and the quantity of pollutant emissions. This should be discussed with the environmental health officer of the Local Authority.

Ground Source Heat Pumps

Ground source heat pumps can be used to provide heating and or cooling to the building. Whilst ground source does rely on fossil fuels (indirectly) to provide the energy source, they are considered renewable given their high coefficient of performance and hence reduced fossil fuel reliance.

This can be one of four methods:

1. Closed horizontal loops, generally comprising a number of flow and return horizontal coiled loops sometimes called “slinkies”.
2. Closed vertical loops, generally comprising a number of flow and return vertical loops to approximately 100m.
3. Open loop, generally comprising of an abstraction and rejection well.
4. Abstraction only open loop, comprising of an abstraction well with water rejected to either the local sewer systems or river/water course.

Reasons for Excluding this Technology for this Site

In order to provide the anticipated heating and cooling boreholes would be required with sufficient distance needed between them. With the site having limited external areas, ground source heat pumps are deemed not suitable for this project and have not been considered further.

Existing services within the ground would prohibit the installation of a borehole type heat pump. Space limitations prohibit the installation of a slinky type heat pump.

Wind Turbines

This section covers both large scale and micro wind solutions.

Large scale wind generation systems have capacities over 100kW and are usually used to power larger developments such as, larger scale housing, industrial estates and hotels with many rooms. These systems cannot be roof mounted due to their size and weight.

Reasons for Excluding this Technology for this Site

Due to the large capital cost and surroundings, large scale wind turbine systems are not considered viable at this project.

It is difficult to obtain predictable or large amounts of wind energy in city centre locations, as they require non-turbulent, horizontal air streams to be most effective. Surrounding buildings, trees, etc can cause significant issues with regards to micro and large scale installations unless the rotors are positioned at a considerable height.

Micro wind turbine technology has been found to be extremely difficult to achieve a contribution economically. A significant number of units would be required to provide any reasonable energy savings which would have serious visual impact implications.

Tall buildings give their own specific problems in that the building act as a spoiler, pushing wind upwards and over the turbine, reducing effectiveness considerably.

Additional considerations with large and micro wind solutions are the potential issues from stroboscopic light, topple distance, noise, impact on wildlife and structural enhancements which all raise major concerns given the building central London location.

Given the building location in central London and its close proximity to nearby buildings, achieving an acceptable solution that will provide sufficient renewable contribution as well as overcome the installation impacts is unlikely and therefore has not been considered for this project.