THE ALDERS

LONDON PLAN ENERGY STATEMENT

November 2020

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LONDON PLAN ENERGY STATEMENT

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1	First issue	LA	RT	ADP	11.08.2020
2	Updated data to GLA 2020 carbon emission reporting spreadsheet	LA	RT	ADP	07.10.2020
3	Updated system design	LA	RT	ADP	05.12.2020
4	Minor amendments with WYG's comments	LA	RT	ADP	06.11.2020

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1. EXECUTIVE SUMMARY

This energy statement has been prepared by CBG Consultants on behalf of Wandsworth Borough Council: Housing Strategy and Development ("Applicant") in support of its planning application for the redevelopment of land at The Alders in the London Borough of Wandsworth.

The proposal is demolition of existing single storey garages, residents refuse and ancillary storage sheds and redevelopment of the site for affordable residential units within part 3, 4 and 6 storey building together with ancillary residents storage, car parking, bicycle storage, refuse storage, landscaping and communal amenity space. There are no conditioned non-domestic areas. The total internal floor area of the dwellings is 2,307m^2. The accommodation types and floor areas are listed below:

Dwelling Type	Number of units	Unit Floor Area (m^2)
3B5P	4	101
2B3P (W/C)	3	71
1B2P	11	50
2B4P	16	71

Table 1: Schedule of accommodation.

1.1 London Plan - Reduction in Carbon Emissions

The GLA's pre-application report (6 August 2020) states 'applicants should follow the GLA Energy Assessment Guidance 2018', but that applicants should be familiar with the draft 2020 version of this guidance. We have also been advised that schemes determined after 7th July 2020 will be required to contribute the current Carbon Offset Fund Price of £95 per tonne. We have therefore used the new draft GLA carbon emission reporting spreadsheet (v1.2_2020).

As a wholly domestic development, the requirements of the zero-carbon target are:

- Energy demand reduction measures need to contribute to more than 10% of the reduction.
- A minimum 35% reduction (over the baseline) is required from improvement measures on site.
- The remainder can be compensated with carbon offset payments.

Carbon savings have been demonstrated using the London Plan "Be Lean, Be Clean, Be Green" hierarchy:

- Be Lean: High specification of building fabric and energy efficient services to minimise energy demand, including Mechanical Ventilation with Heat Recovery (MVHR).
- Be Clean: The site is not currently suitable for a local CHP system or connection to a district network. Therefore, no carbon savings are possible using this measure (although connect to a network in the future will be possible).
- Be Green: The heating and hot water for all dwellings will be provided by Air Source Heat Pumps (ASHPs) with additional carbon offset from photovoltaics.

The chart below shows the savings achieved at each stage of the process.

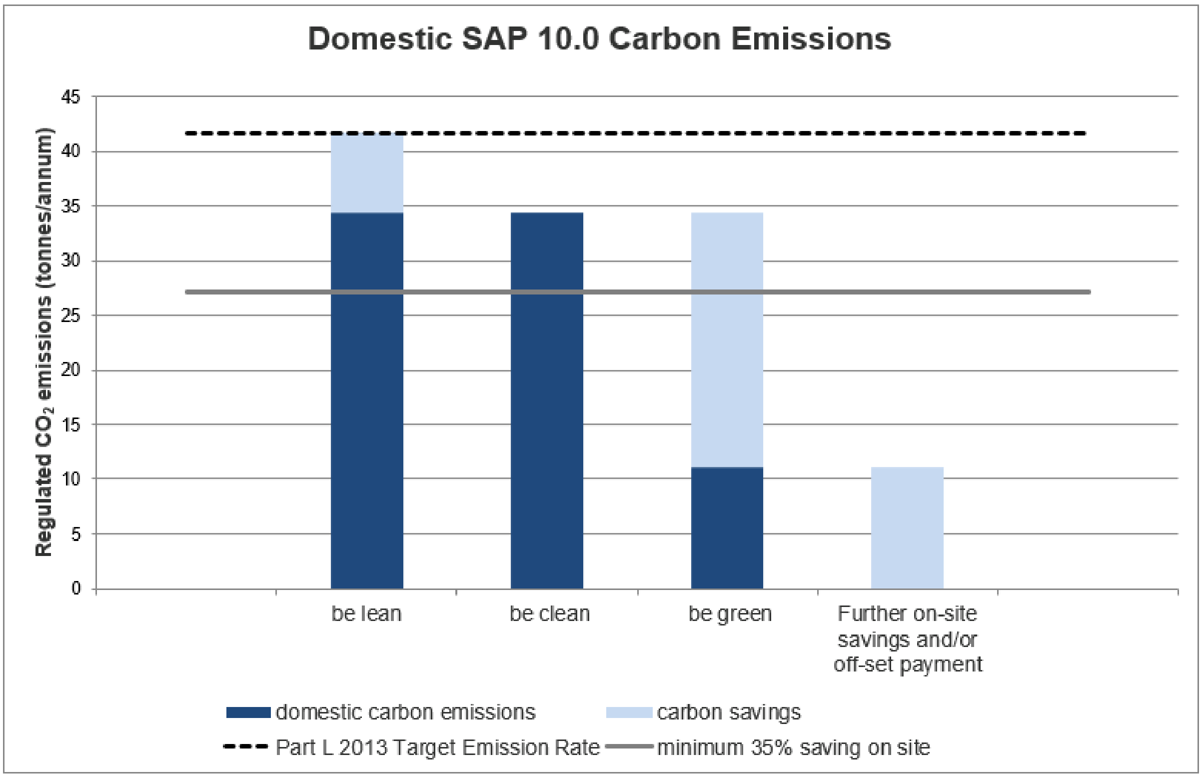

Figure 1: Regulated domestic carbon dioxide savings from each stage of the energy hierarchy.

The efficient building fabric and ventilation system saves 7.4 tonnes over the baseline. This provides an 18% improvement which is greater than the 10% London Plan target for the Be Lean stage.

The use of the ASHPs and PV contribute a further saving of 23.2 tonnes, giving a total reduction of 73% over the baseline which significantly exceeds the 35% London Plan target for on-site savings.

This leaves a remaining 11.2 tonnes of annual carbon emissions where offset payments apply. At a cost of £95 per tonne for 30 years, the cash in-lieu contribution will be £31,868.

1.2 Wandsworth Borough Requirements

The relevant Local Plan policies are Core Strategy Policy IS2 and Development Management Plan Policy DMS3. However, as the borough's requirements regarding energy and carbon align with the London Plan, these are satisfied.

1.3 Building Regulations Requirements

For the proposed design, both the Dwelling Emission Rate and Fabric Energy Efficiency comply with the domestic Part L1A targets.

The calculated carbon emission rate for The Alders is lower than the Part L1A target:

- Average Dwelling Emission Rate (DER) (kg.CO_2/m^2): 10.80
- Average Target Emission Rate (TER) (kg.CO_2/m^2): 29.63

The scheme's Dwelling Fabric Energy Efficiency is also less than the target:

- Average Dwelling Fabric Energy Efficiency (DFEE) (kWh/m^2): 48.08
- Average Target Fabric Energy Efficiency (TFEE) (kWh/m^2): 59.40

2. INTRODUCTION

This energy statement has been prepared by CBG Consultants on behalf of Wandsworth Borough Council: Housing Strategy and Development ("Applicant") in support of its planning application for the redevelopment of land at The Alders in the London Borough of Wandsworth.

2.1 Description of the project

Demolition of existing single storey garages, residents refuse and ancillary storage sheds and redevelopment of the site for affordable residential units within part 3, 4 and 6 storey building together with ancillary residents storage, car parking, bicycle storage, refuse storage, landscaping and communal amenity space. There are no conditioned non-domestic areas. The glazing to floor area ratio for the development is 24.7%. The glazing to façade area ratio is 24.2%.

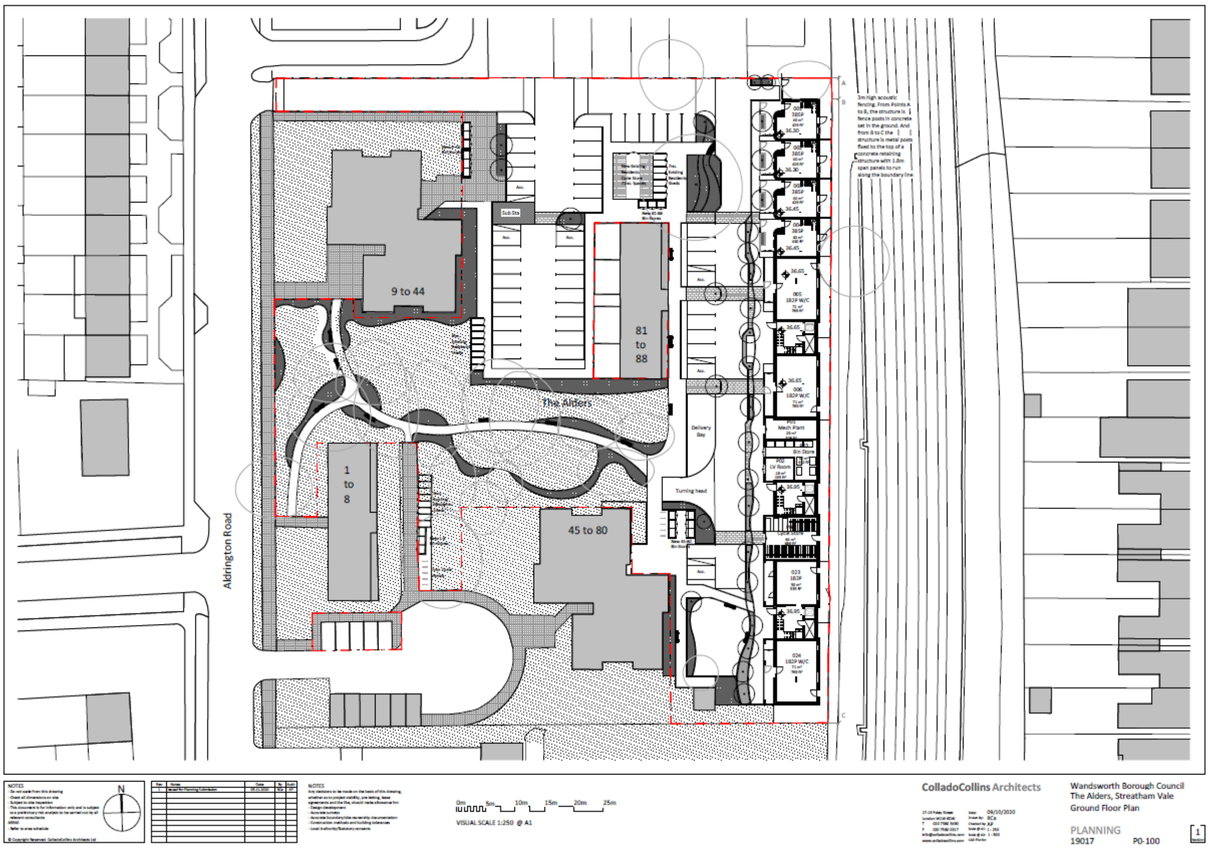

Figure 2: Proposed site plan.

The accommodation types and floor areas are listed below:

Dwelling Type	Number of units	Unit Floor Area (m^2)
3B5P	4	101
2B3P (W/C)	3	71
1B2P	11	50
2B4P	16	71

Table 2: Schedule of accommodation.

2.2 Greater London Authority Carbon Emissions Targets

2.2.1 Carbon Reduction

The GLA's pre-application report (6 August 2020) states 'applicants should follow the GLA Energy Assessment Guidance 2018', but that applicants should be familiar with the draft 2020 version of this guidance. We have also been advised that schemes determined after 7th July 2020 will be required to contribute the current Carbon Offset Fund Price of £95 per tonne. We have therefore used the new draft GLA carbon emission reporting spreadsheet (v1.2_2020).

As a wholly domestic development, the requirements of the zero-carbon target are:

- Energy demand reduction measures need to contribute to more than 10% of the reduction.
- A minimum 35% reduction (over the baseline) is required from improvement measures on site.
- The remainder can be compensated with carbon offset payments.

It should be noted that these targets apply to regulated carbon only. Regulated carbon refers to the emissions associated with internal lighting, heating, hot water, air conditioning and mechanical ventilation. Other consumptions such as small power equipment (PCs, TVs, laptops etc.) are "unregulated". Despite unregulated carbon not having a specific target, it is a condition of the London Plan that it is stated.

Regulated energy calculations for the dwellings have been carried out using FSAP 2012 software which is accredited for use in Part L1A calculations. The unregulated energy has been calculated using BRE Domestic Energy Model (BREDEM 2012). These calculations can be found in Appendix 3.

2.2.2 Carbon Emissions Fuel Factors

As encouraged by the GLA, SAP 10.0 carbon factors have been used. These factors account for recent decarbonisation of the electricity grid, making it a more favourable fuel. It should be noted that calculations for building regulations are yet to implement these new factors causing a discrepancy in results for different approval bodies.

2.2.3 Energy Hierarchy

A further requirement is that energy strategy is developed in accordance with the London Plans' energy hierarchy:

- Be Lean: savings from energy demand reduction.
- Be Clean: savings from heat networks.
- Be Green: savings from renewable energy.

2.3 Wandsworth Borough Requirements

The relevant Local Plan policies are:

- Core Strategy Policy IS2: Sustainable design, low carbon development and renewable energy
- Development Management Plan Policy DMS3: Sustainable design and low-carbon energy

Both policies refer to London Plan Policy 5.2 and the energy hierarchy.

Last year Wandsworth Council declared a climate emergency and set targets of becoming a carbon neutral organisation by 2030 and a zero-carbon by 2050[1]. The Wandsworth Environment and Sustainability Strategy 2019 –2030 states[2]:

> *"In line with the draft London Plan in meeting the zero-carbon target a minimum on-site reduction of at least 35 per cent beyond Building Regulations is expected. Residential development should aim for 10 per cent, and non-residential should aim to achieve 15 per cent carbon reductions through energy efficiency measures.*
>
> *Only where it can be clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided though a cash in lieu contribution to the Council's carbon offset fund or off-site provided that an alternative proposal is identified and delivery is certain."*

Wandsworth Borough planning requirements follow the GLA guidance so compliance with the London Plan will also satisfy these.

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1 https://www.wandsworth.gov.uk/climatechange/
2 https://www.wandsworth.gov.uk/media/6769/wandsworth_environment_and_sustainability_strategy_2019_30.pdf, page 4.

2.4 Building Regulations – Part L1A

Domestic areas come under Part L1A 2013 of the building regulations, this sets out five compliance criteria with the scope of this report covering the first one[3]:

> *"the calculated rate of CO_2 emissions from the dwelling (the dwelling CO_2 Emission Rate, DER) must not be greater than the Target CO_2 Emission Rate (TER)."*

The DER and TER calculations require the regulated carbon emissions from the proposed dwelling to be less than the target. The target emission rate is based on a notional building, with the same basic geometry as the actual building, but with U-values, glazing and plant systems set by the approved methodology.

> *"Additionally [..] the Calculated Dwelling Fabric Energy Efficiency (DFEE) rate must not be greater than the Target Fabric Energy Efficiency rate."*

The fabric energy efficiency applies a separate limit to the building fabric itself. The intention behind this is to place an increased importance on this area as building fabric is likely to outlast building services and renewable technologies.

3 The Building Regulations 2010, L1A Conservation of Fuel and Power in New Dwellings 2013 edition with 2016 amendments, page 4.

3. LONDON PLAN

3.1 Baseline Case

The baseline CO_2 emissions are calculated from the 'notional' building using the Part L software tools. The 'notional' building consists of standard set of fabric and services parameters which deliver the Target Emissions Rate. This is then used as the Baseline emissions from which savings from Be Lean, Be Clean, and Be Green measures are calculated. As stated by the guidance document, heating has been provided by gas boilers and active cooling is provided by electrically powered equipment. Table 3 below shows the regulated and unregulated baseline figures.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	41.7	22.5

Table 3: Baseline carbon emissions.

3.2 Demand Reduction (Be Lean)

3.2.1 Passive Measures

Insulation

U-values for external elements have been improved from the Part L notional standards, as shown in the table below.

Element	U-Value (W/m^2K)	G-Value	Part L Notional Values (W/m^2K)
Walls	0.15	-	0.18
Ground Floors	0.11	-	0.13
Exposed Floors	0.11	-	0.13
Roof	0.11	-	0.13
Solid Door	1.00	-	1.0
Window (Glass & Frame)	1.30	0.50	1.4

Table 4: Building fabric U-values.

Air Tightness

An air permeability of 3 $m^3/m^2/hr$ (@50pa) has been allowed for these calculations, and this represents a low leakage rate even for a new building. The intention will be to build the scheme to be as airtight as possible, however this will remain speculative until construction is finished. Following completion, the result of the pressure test will be used to update the calculations, so there is potential for the offset payments to reduce following a positive result.

Thermal Bridging

Accredited construction details have been included in the modelling.

3.2.2 Active Measures

Heating

As required by the energy hierarchy, for the Be Lean stage this is provided by communal gas boilers with an efficiency that matches the notional building. This enables the savings from other energy efficiency measures to be seen in the results at this stage. The heating will be controlled by a programmer and a least two thermostats.

Hot Water

Domestic hot water will be provided by the community heating system via heat interface units in each apartment, with a temperature top-up from an instantaneous hot water heater. Although there is no hot water storage in apartments, there will be a buffer vessel on the roof to help manage peaks in the hot water load. All primary pipework will be insulated.

Cooling

Cooling will be provided by an air-source chiller, a chilled water communal loop linked to cooling interface units in each apartment, and fan coil units in each apartment. The manufacturer's declared efficiency (SEER) for the proposed chiller is 4.88 (see the Be Green section for the data sheet). This is an energy efficient way to provide cooling in summer which is shown to be required in the Overheating Report written by CBG Consultants.

Ventilation

The mechanical ventilation with heat recovery (MVHR) systems will have low specific fan power and high heat recovery efficiencies (at least 90%) to reduce heat loss and energy consumption.

Lighting

All dwellings will be designed with 100% low energy lighting.

3.2.3 Be Lean Carbon Emissions Reduction

Table 5 shows the resulting carbon emissions before and after applying the "Be Lean" measures outlined above.

The carbon emissions are predicted to be lower than the base case due to the high performance of building fabric and services. These measures save 7.4 tonnes of carbon which is an 18% reduction over the baseline. As this is more than 10%, the London Plan criterion for this stage is met.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	41.7	22.5
After energy demand reduction (be lean)	34.3	22.5

Table 5: Be Lean carbon emissions.

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	59.40	48.08	19%

Table 6: Fabric Energy Efficiency (FEES).

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	41.7		
Be lean	34.3	7.4	18%

Table 7: Site wide carbon saving after Be Lean stage.

3.3 System Efficiency (Be Clean)

The draft London Plan Policy SI3 heating hierarchy states developments should have a communal low-temperature heating system and should select a heat source in accordance with the following heating hierarchy:

a) Connect to local existing or planned heat networks.
b) Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required).
c) Use low-emission combined heat and power (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network).
d) Use ultra-low NOx gas boilers.

3.3.1 Connection to District Heating Network

The map below shows the proposed development (green circle) in relation to potential district heat networks (orange and purple) and existing ones (red). The nearest existing network are all on the other side of the Thames, and even the nearest potential networks are approximately 5km away. The Wandsworth Heat Map Report states the site is not within one of the nine identified heat load clusters. There is no Energy Master Plan for Wandsworth.

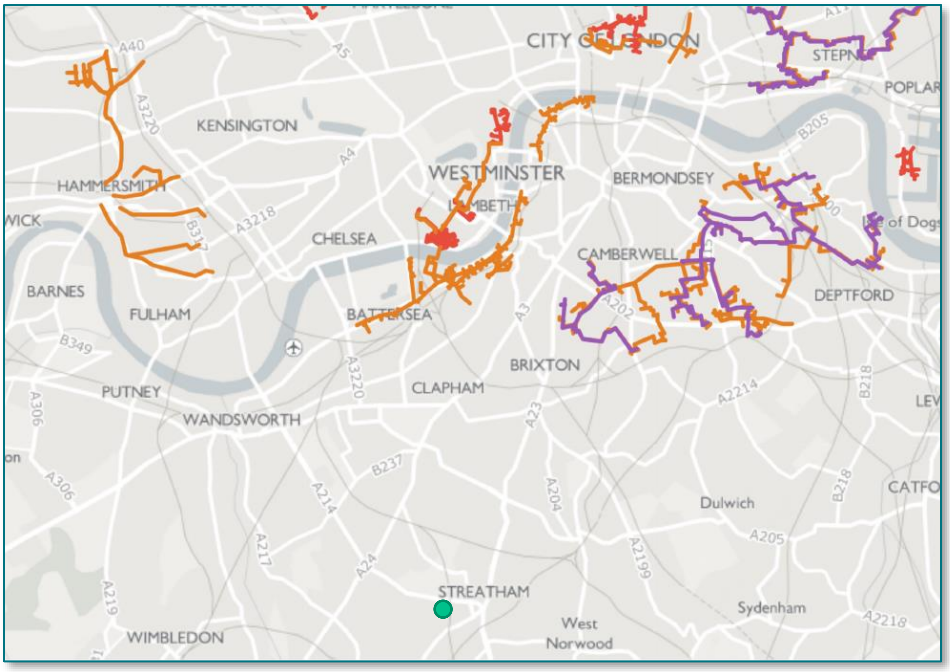

Figure 3: London heat map. The green dot shows the site. Red indicates existing networks, proposed networks are shown in orange and purple.

For a development of this size, it would not be economical to connect into a heat network at this stage. However, by using a community heating system in the development, a future connection would not be compromised. See the Be Green Section for more information about the proposed system and its ability to connect into a district heating system.

3.3.2 Zero Emission and/or Local Secondary Heat Sources

The second step of the heating hierarchy encourages the exploitation of local energy opportunities to maximise the use of locally available energy sources whilst minimising primary energy demand and carbon emissions. Sources of waste heat are not available on or adjacent to the site.

3.3.3 Combined Heat and Power (CHP)

CHP has not been considered appropriate for the site on the basis that:

- There is insufficient number of dwellings to make it viable.
- The revised fuel factors reflecting decarbonisation of grid electricity make CHP unfavourable.

3.3.4 Use Ultra-Low Nox Gas Boilers

A heating strategy led by ultra-low NOx gas boilers should only be considered when it has been clearly demonstrated that all other options in the heating hierarchy (a to c) have been fully investigated and ruled out. The above options have been ruled out, but the use of gas boilers are not required, as the proposed solution uses heat pumps as a green energy source.

3.3.5 Carbon Emissions Reduction

Since a district heating connection or on-site CHP is unviable, no carbon emissions reductions are available using these measures.

3.4 Renewable Energy (Be Green)

3.4.1 Technology Options

An initial review was conducted to eliminate any technologies which from the outset have been identified as unviable. This can be found in Appendix 1. From this study, air source heat pumps (ASHPs) and photovoltaics (PV) have been identified as the most appropriate for the site.

Air Source Heat Pumps

The proposed design uses Heat Interface Units (HIUs) in each dwelling connected to a central hot water loop. ASHPs on the roof will heat the central water loop to 55°C (50°C return). The proposed system will be able to connect to future heat networks as there is a communal heating loop.

Cooling will be provided by the same roof top ASHPs. The chilled water communal loop will be linked to cooling interface units in each apartment and fan coil units in living spaces and bedrooms.

Figure 4 shows the efficiency data for the for the proposed communal ASHP (Mitsubishi EAHV-P1500YBL-N) to be used in the carbon calculations: an SCOP of 2.89 and an SEER of 4.88.

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Chillers

Product Information

e-Series Modular Chiller (90-1,080kW)
Cooling Only or Heat Pump

Making a World of Difference

3No. units for the Alders

MODEL			EAHV-P900YA-N Heating/Cooling	EAHV-P1500YBL-N Heating/Cooling	EAHV-P1800YBL-N Heating/Cooling
POWER SOURCE			3-phase 4-wire 380-400-415v, 50/60Hz	3-phase 4-wire 380-400-415v, 50/60Hz	3-phase 4-wire 380-400-415v, 50/60Hz
COOLING CAPACITY *1 WATER		kW	90.0	150.0	180.0
		kcal/h	77,400	129,000	154,800
		BTU/h	307,080	511,800	614,160
	Power Input	kW	30.6	45.1	59.01
	EER (Pump input is not included)		3.30	3.33	3.05
	IPLV *5		6.34	6.55	6.33
	Water Flow Rate	m³/h	15.5	25.8	31
COOLING CAPACITY (EN14511)*2 WATER		kW	90	148.6	177.8
		kcal/h	77,400	127,779	152,874
		BTU/h	307,080	506,955	606,517
	Power Input	kW	29.2	46.52	61.25
	EER		2.94	3.19	2.90
	Eurovent Efficiency Class		B	A	B
	ESEER *6		4.71	4.74	4.45
	SEER (ηsc) (BS EN14825)		4.88 (192%)	4.62 (181%)	4.58 (180%)
	Water Flow Rate	m³/h	15.5	25.8	31.0
	Minimum Water Circuit Volume	L	780	1450	1450
HEATING CAPACITY *3		kW	90.0	150	180
		kcal/h	77,400	129,000	154,800
		BTU/h	307,080	511,800	614,160
	Power Input *3	kW	25.71	44.59	55.68
	COP		3.50	3.36	3.23
	Water Flow Rate	m³/h	15.5	25.8	31.0
HEATING CAPACITY (EN14511)*4		kW	90.0	151.42	182.24
		kcal/h	77,400	130,221	156,726
		BTU/h	307,080	516,645	621,803
	Power Input *3	kW	27.6	46.01	57.92
	COP		3.25	3.29	3.15
	Eurovent Efficiency Class		A+	A	B
	SCOP Low/Medium		3.66 (143%) / 2.89 (113%)	3.24 (127%) / 2.85 (112%)	3.24 (127%) / 2.85 (112%)
	Water Flow Rate	m³/h	15.5	25.8	31.0

Figure 4: Manufacturer efficiency data for proposed system design.

Photovoltaics

The amount of PV has been maximised on the available roof spaces, taking account for the need to access plant areas – see Figure 5. A total PV array of approximately 21.6 kWp could be accommodated in these areas (72 x 300 W panels = 21.6 kWp). Panels will have an inclination of ~10° and will face south. The electricity generated from the PV array will be used in the landlord areas or exported to the grid, but for the purposes of reporting carbon savings, the energy generated has been split equally between dwellings (21.6 kWp ÷ 34 dwellings = 0.635 kWp per dwelling).

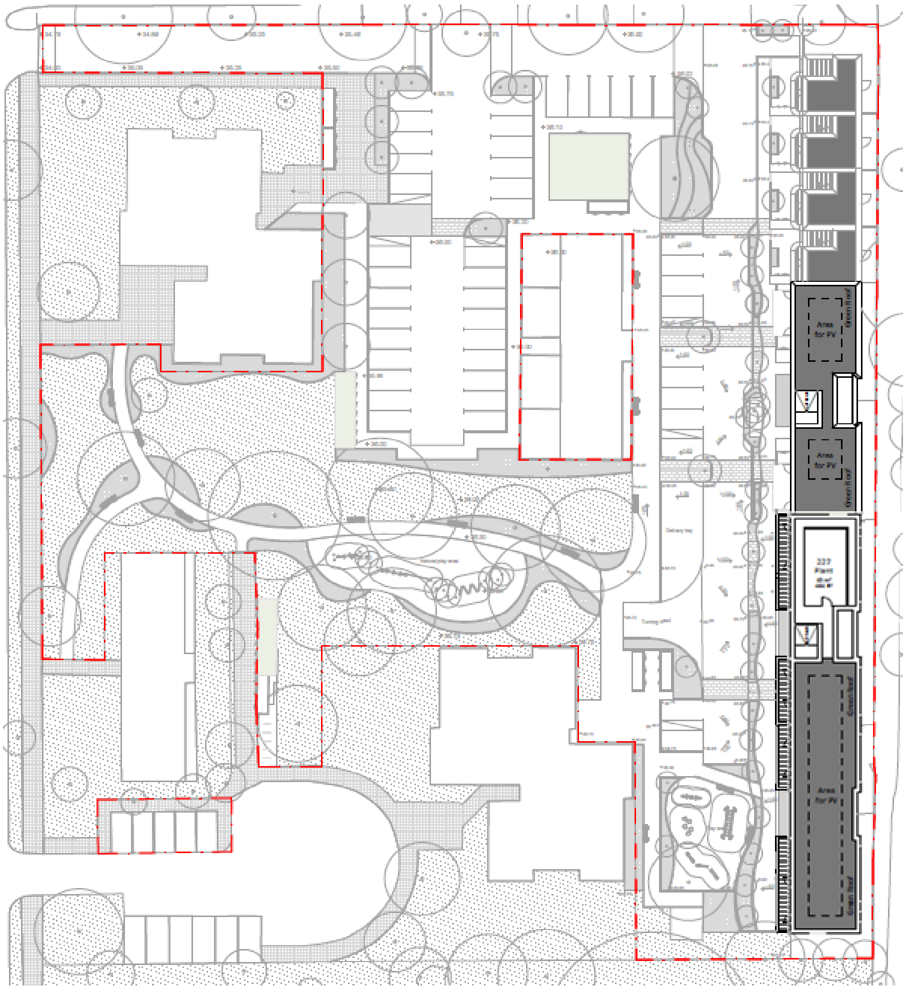

Figure 5: Proposed area for PV panels on roofs (within dashed lines).

3.4.2 Carbon Emissions Reduction

Table 8 shows the carbon reduction when the ASHPs and PV are included in the design. The regulated carbon emissions are now reduced to 11.2 tonnes, corresponding to a 73% saving over the baseline. This greatly exceeds the 35% on-site reduction required for the London Plan.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	41.7	22.5
After energy demand reduction (be lean)	34.3	22.5
After heat network connection (be clean)	34.3	22.5
After renewable energy (be green)	11.2	22.5

Table 8: Be green carbon emissions.

To achieve zero carbon, these 11.2 tonnes can be offset through the payment mechanism. Each borough can have its own an established price for this offsetting. However, in the case of Wandsworth it is £95/tonne for a period of 30 years, as stated in the draft London Plan.

At this rate, the 11.2 tonnes of regulated carbon a year would need to be compensated with an upfront payment of £31,868 (~11.2 tonnes x £95/tonne/year x 30 years).

It should be noted that this is all paid before the building is occupied and no further payments are due afterwards. The "30 years" is only relevant in calculating the amount to be paid upfront.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	41.7		
Be lean	34.3	7.4	18%
Be clean	34.3	0.0	0%
Be green	11.2	23.2	56%
Total Savings	-	30.5	73%
	-	CO2 savings off-set (Tonnes CO_2)	-
Off-set	-	**335.5**	-

Table 9: Site wide carbon saving after Be Green stage.

3.5 Energy Storage

Although there is no hot water storage in apartments, there will be a buffer vessel on the roof to help manage peaks in the hot water load. As more buildings switch to electric heating, the peak demand on the grid needs to be managed. Having local thermal storage helps reduce these peaks and hot water can be generated during low demand. As smart meters become more common it is likely that electricity prices will vary with demand and using electricity during low demand will be cheaper.

4. BUILDING REGULATIONS COMPLIANCE

The requirements for building regulations slightly differ from the London Plan. They are generally less onerous but are also based on different carbon factors, so the predicted emissions will differ for this reason. As per the draft London Plan guidance, results have been reported after both the Be Lean and Be Green Stages.

4.1 Building Regulations Compliance – Be Lean

The calculated carbon emission rate for The Alders is lower than the Part L1A target:

- Average Dwelling Emission Rate (DER) (kg.CO_2/m^2): 17.48
- Average Target Emission Rate (TER) (kg.CO_2/m^2): 20.14

The scheme's Dwelling Fabric Energy Efficiency is also less than the target:

- Average Dwelling Fabric Energy Efficiency (DFEE) (kWh/m^2): 48.08
- Average Target Fabric Energy Efficiency (TFEE) (kWh/m^2): 59.40

As a result, the dwellings are compliant with criterion 1 of Part L1A of the building regulations.

4.2 Building Regulations Compliance – Be Green

The calculated carbon emission rate for The Alders is lower than the Part L1A target:

- Average Dwelling Emission Rate (DER) (kg.CO_2/m^2): 10.80
- Average Target Emission Rate (TER) (kg.CO_2/m^2): 29.63

The scheme's Dwelling Fabric Energy Efficiency is also less than the target:

- Average Dwelling Fabric Energy Efficiency (DFEE) (kWh/m^2): 48.08
- Average Target Fabric Energy Efficiency (TFEE) (kWh/m^2): 59.40

As a result, the dwellings are compliant with criterion 1 of Part L1A of the building regulations.

5. CONCLUSIONS

5.1 London Plan

The Be Lean, Clean, Green hierarchy has been followed to achieve a low energy, low carbon design for The Alders development:

- Be Lean: High specification of building fabric and energy efficient services to minimise energy demand, including Mechanical Ventilation with Heat Recovery (MVHR).
- Be Clean: The site is not currently suitable for a local CHP system or connection to a district network. Therefore, no carbon savings are possible using this measure (although connect to a network in the future will be possible).
- Be Green: The heating and hot water for all dwellings will be provided by Air Source Heat Pumps (ASHPs) with additional carbon offset from photovoltaics.

Through efficient building fabric, the Be Lean stage achieves an 18% reduction which exceeds the London Plan's 10% target for this stage. With the inclusion of air source heat pumps and PV in the Be Green stage, an overall reduction of 73% has been calculated, greatly exceeding the 35% minimum on-site reduction. With a carbon offset payment of £31,868, the scheme is able to reach zero carbon and comply with the London Plan targets.

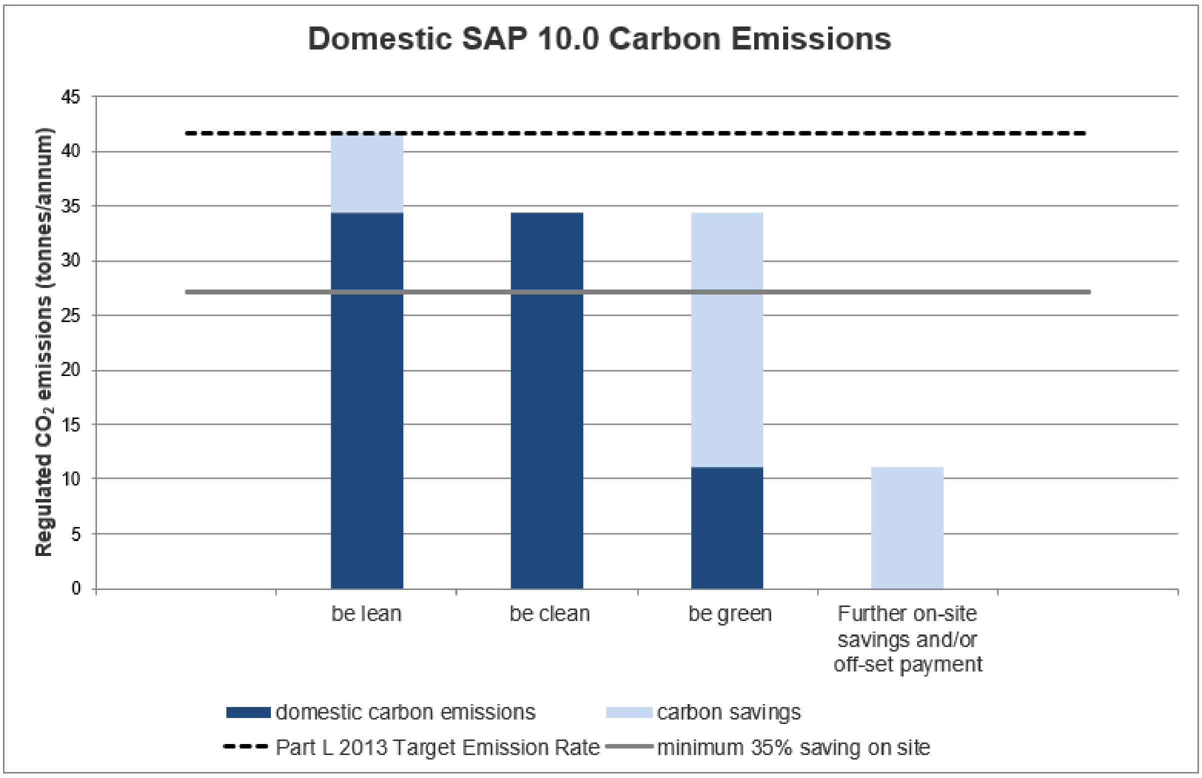

Figure 6: Carbon reduction summary.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	41.7		
Be lean	34.3	7.4	18%
Be clean	34.3	0.0	0%
Be green	11.2	23.2	56%
Total Savings	-	30.5	73%
	-	CO2 savings off-set (Tonnes CO_2)	-
Off-set	-	**335.5**	-

Table 10: Site wide carbon emissions and savings.

5.2 Building Regulations

Both the Dwelling Emission Rate and Fabric Energy Efficiency comply with the domestic Part L1A targets.

APPENDIX 1: PRELIMINARY APPRIASAL OF RENEWABLE ENERGY OPTIONS

This appendix summarises the preliminary analysis of renewable energy options, and identifies which should be assessed in further detail, and which should be discounted because of clear technical reasons or other obstacles.

LZC Technology	Basic Technical Information	Technical, Environmental & Economic implications / Considerations	Suited Application	Site Specific Comment	Detailed Analysis?
Solar thermal	Solar collectors (flat plate or tube) transfer energy into transfer liquid to a closed loop twin coil hot water cylinder	+ Government grants available (RHIs) +/- Can meet a significant proportion of the DHW demand - Efficiency effected by site factors – shading, orientation and roof/ground space -Requires considerable hot water demand all year round to be finically beneficial	Domestic and commercial applications with high annual hot water load; leisure centres, canteens, washrooms	There is limited roof space and the hot water load may not be consistent enough to make this viable. Carbon savings will be minimal.	No
Wind turbine	Turbine/generator converts wind energy to electrical power.	+ Government grants available (FITs) + Allows on site generation of renewable electricity - Can create structural, vibrations and noise implications - Not suited for urban environments - Costs can be high in relation to the actual amount of electricity generated - Potential for additional planning issues	Large sized turbines in non-urban or offshore locations will be more effective	The site is located in a dense urban area and further planning approvals would be required.	No
Solar Photovoltaics	Converts sunlight to DC electrical power which then using an inverter to convert to DC.	+ Allows on site generation of renewable electricity + Generally payback between 7-12 years + Low maintenance requirements - No government grants available - Efficiency effected by site factors – shading, orientation and roof/ground space	Wide range of building types particularly buildings with limited solar shading and south facing roof	There is little roof space for the size of the development and the recent removal of Feed-In and Export Tariff make this less favourable. Although the area available for PV will not achieve a 35% carbon alone, it could still be included in the design to maximise carbon savings.	Yes
Air source heat pump	Air Source Heat Pumps (ASHP) capture heat from the outside air and transfer the heat directly to the air inside the building or transferring the heat to a liquid medium that can be pumped around the building	+ Lower installation cost that ground source heat pump + Can provide heating and cooling + Government grants available (RHIs) - COP is not as good during the heating season when the outside air temperature is often less than the ground temperature - Can restrict distribution strategies	Wide range of building types particularly building designed to have low temperature heat emitters.	The apartments have enough space on the roof for the outdoor unit, where acoustics and aesthetics are unlikely to be an issue.	Yes
Ground Source Heat Pump	Ground Source Heat Pumps (GSHP) capture heat from the ground and transfer the heat	+ COP is better than air source heat pumps + Government grants available (RHIs) - Requires area for ground collector or borehole - High initial capital cost	Suits building designed to have low temperature heat emitters with sufficient	The high capital cost of this is prohibitive.	No

	to a liquid medium that can be pumped around the building	- Can restrict distribution strategies	space for necessary ground works		
Biomass	Uses biomass as a fuel source for space heating and hot water	+ Government grants available (RHIs) + Renewable source of heating - Requires large fuel storage capacity - Generally a large capital cost	Building/site with sufficient access and storage facilities and a capable maintenance team	There is insufficient storage space and very limited access for regular deliveries to warrant further investigation.	No

APPENDIX 2: KEY MODELLING INPUTS

Parameter	Units	Comments
Corridor Heated	-	No
Accredited Construction Details (ACDs)	-	Yes
Water use target	l/p/day	< 105
Air Permeability	$m^3/hr.m^2$	3
Wall U-value	W/m^2K	0.15
Roof U-value	W/m^2K	0.11
Ground / Exposed Floor U-value	W/m^2K	0.11
Window U-value	W/m^2K	1.3
Window g-value	-	0.5
Glazed Door U-value	W/m^2K	1.3
Solid Door U-value	W/m^2K	1.0
Party Wall construction	-	Fully-filled cavity
Weight of building	-	Light
MVHR	-	MRXBOXAB-ECO3 (Townhouses); MRXBOXAB-ECO2 (Flats)
Heat Pump	-	Community ASHP – Daikin Alterma
Seasonal Heating Efficiency	%	289
Seasonal Cooling Efficiency	%	488
Heating Emitter	-	Radiators
Heating Controls	-	Charging system linked to use of community heating, programmer & at least 2 room thermostats
Heat Distribution System	-	Piping >= 1991, pre-insulated, low temp, variable flow
Cylinder volume	l	N/A
Percentage low energy light fittings	%	100

APPENDIX 3: SUPPORTING BREDEM CALCULATION (SAMPLE)

BREDEM Method for Dwelling Unregulated Energy Consumption		
Building Name	Townhouse 1	Townhouse 2
Treated Floor Area (m2)	100.92	100.92
No. Occupants	2.7	2.7
User input (if no. occupants known)	5	5
No. Occupants	5.0	5.0
Appliance Energy Consumption		
Initial annual appliance energy, E_A' (kWh/yr)	3474	3474
Month	Energy Consumption (kWh)	Energy Consumption (kWh)
1	430	430
2	399	399
3	414	414
4	342	342
5	278	278
6	200	200
7	160	160
8	149	149
9	171	171
10	236	236
11	302	302
12	383	383
Annual Energy Consumption (kWh/yr)	3464	3464
Cooking Energy Consumption		
Type of cooker	Normal size cooker: electric	Normal size cooker: electric
Is the cooker an Aga type appliance (on all the time)?	No	No
E_C1A	275	275
E_C1B	55	55
E_C2A	0	0
E_C2B	0	0
E_C1	550	550
E_C2	0	0
Range power consumption (W)	1500	1500
Month	E_C,m (kWh)	E_C,m (kWh)
1	46.7	46.7
2	42.2	42.2
3	46.7	46.7
4	45.2	45.2
5	46.7	46.7
6	45.2	45.2
7	46.7	46.7
8	46.7	46.7
9	45.2	45.2
10	46.7	46.7
11	45.2	45.2
12	46.7	46.7
Annual Energy Consumption (kWh/yr)	550	550
Month	E_R,m (kWh)	E_R,m (kWh)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Annual Energy Consumption (kWh/yr)	-	-
Total Cooking Energy (kWh/yr)	550	550
Total Unregulated Energy Consumption (kWh)	**4,014**	**4,014**
Total Unregulated Energy Consumption (Site)	**96,580**	kWh
Total Carbon Emissions - 2012	50,125	KgCO2
Total Carbon Emissions - SAP 10	22,503	KgCO2

APPENDIX 4: AIR QUALITY IMPACT ASSESSMENT

To assist with the assessment of air quality impacts, the following table has been completed. The Alders development site has been designed to operate using electricity as the only fuel:

Energy source	Total fuel consumption (MWh/year)
Grid electricity	64.4
Domestic/communal gas boilers	0
Gas CHP	0
Connection to existing DH network	0
Other gas use (e.g. cookers)	0

APPENDIX 5: BE LEAN MODELLING OUTPUT SHEETS

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Townhouse 1

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	39.87	(1a) x	2.7	(2a) =	107.65	(3a)
First floor	34.85	(1b) x	3	(2b) =	104.55	(3b)
Second floor	26.2	(1c) x	2.9	(2c) =	75.98	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	100.92	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		288.18	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

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

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.3	0.3	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.3	0.3	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(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			2.43	x	1	=	2.43			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			4.88	x1/[1/(1.3)+ 0.04]		=	6.03			(27)
Windows Type 2			2.92	x1/[1/(1.3)+ 0.04]		=	3.61			(27)
Windows Type 3			13.47	x1/[1/(1.3)+ 0.04]		=	16.65			(27)
Floor			39.87	x	0.11	=	4.3857			(28)
Walls	172.41	26.44	145.97	x	0.15	=	21.9			(29)
Roof	39.87	0	39.87	x	0.11	=	4.39			(30)
Total area of elements, m²			252.15							(31)
Party wall			37.81	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) = 62.12 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7544.31 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 25.65 (36)

DER WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 87.77 (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=	28.4	28.07	27.74	26.09	25.76	24.11	24.11	23.78	24.77	25.76	26.42	27.08	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(39)m=	116.18	115.85	115.52	113.87	113.54	111.89	111.89	111.56	112.55	113.54	114.2	114.86

Average = $Sum(39)_{1...12}$ /12= 113.78 (39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.15	1.15	1.14	1.13	1.13	1.11	1.11	1.11	1.12	1.13	1.13	1.14

Average = $Sum(40)_{1...12}$ /12= 1.13 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.75 (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 99.46 (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=	109.41	105.43	101.45	97.47	93.49	89.52	89.52	93.49	97.47	101.45	105.43	109.41

Total = $Sum(44)_{1...12}$ = 1193.55 (44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	162.25	141.9	146.43	127.66	122.5	105.7	97.95	112.4	113.74	132.56	144.7	157.13

Total = $Sum(45)_{1...12}$ = 1564.93 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	24.34	21.29	21.96	19.15	18.37	15.86	14.69	16.86	17.06	19.88	21.7	23.57	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.72 (55)

DER WorkSheet: New dwelling design stage

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

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

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

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

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

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

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

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

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

(62)m=	207.83	183.08	192.02	171.78	168.08	149.82	143.53	157.98	157.85	178.14	188.81	202.71	(62)

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

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

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

Output from water heater

(64)m=	207.83	183.08	192.02	171.78	168.08	149.82	143.53	157.98	157.85	178.14	188.81	202.71

Output from water heater (annual)$_{1\ldots12}$ | 2101.62 | (64)

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

(65)m=	90.41	80.12	85.15	77.74	77.2	70.44	69.03	73.84	73.11	80.54	83.4	88.71	(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=	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	(66)

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

(67)m=	23.04	20.46	16.64	12.6	9.42	7.95	8.59	11.17	14.99	19.03	22.21	23.68	(67)

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

(68)m=	257.81	260.48	253.74	239.39	221.27	204.24	192.87	190.19	196.94	211.29	229.4	246.43	(68)

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

(69)m=	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	(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=	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	(71)

Water heating gains (Table 5)

(72)m=	121.52	119.23	114.46	107.97	103.76	97.83	92.79	99.25	101.54	108.25	115.83	119.24	(72)

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

(73)m=	466.59	464.39	449.06	424.18	398.67	374.24	358.47	364.83	377.68	402.79	431.67	453.57	(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	0.77	x	4.88	x	10.63	x	0.5	x	0.7	=	12.59	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.5	x	0.7	=	24.05	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.5	x	0.7	=	40.87	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.5	x	0.7	=	65.65	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.5	x	0.7	=	88.44	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.5	x	0.7	=	94.67	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.5	x	0.7	=	88.39	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.5	x	0.7	=	70.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.5	x	0.7	=	49.14	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.5	x	0.7	=	28.63	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.5	x	0.7	=	15.53	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.5	x	0.7	=	10.49	(74)
East	0.9x	0.77	x	2.92	x	19.64	x	0.5	x	0.7	=	13.91	(76)
East	0.9x	0.77	x	2.92	x	38.42	x	0.5	x	0.7	=	27.21	(76)
East	0.9x	0.77	x	2.92	x	63.27	x	0.5	x	0.7	=	44.81	(76)
East	0.9x	0.77	x	2.92	x	92.28	x	0.5	x	0.7	=	65.36	(76)
East	0.9x	0.77	x	2.92	x	113.09	x	0.5	x	0.7	=	80.1	(76)
East	0.9x	0.77	x	2.92	x	115.77	x	0.5	x	0.7	=	81.99	(76)
East	0.9x	0.77	x	2.92	x	110.22	x	0.5	x	0.7	=	78.06	(76)
East	0.9x	0.77	x	2.92	x	94.68	x	0.5	x	0.7	=	67.05	(76)
East	0.9x	0.77	x	2.92	x	73.59	x	0.5	x	0.7	=	52.12	(76)
East	0.9x	0.77	x	2.92	x	45.59	x	0.5	x	0.7	=	32.29	(76)
East	0.9x	0.77	x	2.92	x	24.49	x	0.5	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	2.92	x	16.15	x	0.5	x	0.7	=	11.44	(76)
West	0.9x	0.77	x	13.47	x	19.64	x	0.5	x	0.7	=	64.17	(80)
West	0.9x	0.77	x	13.47	x	38.42	x	0.5	x	0.7	=	125.53	(80)
West	0.9x	0.77	x	13.47	x	63.27	x	0.5	x	0.7	=	206.72	(80)
West	0.9x	0.77	x	13.47	x	92.28	x	0.5	x	0.7	=	301.49	(80)
West	0.9x	0.77	x	13.47	x	113.09	x	0.5	x	0.7	=	369.49	(80)
West	0.9x	0.77	x	13.47	x	115.77	x	0.5	x	0.7	=	378.24	(80)
West	0.9x	0.77	x	13.47	x	110.22	x	0.5	x	0.7	=	360.1	(80)
West	0.9x	0.77	x	13.47	x	94.68	x	0.5	x	0.7	=	309.32	(80)
West	0.9x	0.77	x	13.47	x	73.59	x	0.5	x	0.7	=	240.43	(80)
West	0.9x	0.77	x	13.47	x	45.59	x	0.5	x	0.7	=	148.95	(80)
West	0.9x	0.77	x	13.47	x	24.49	x	0.5	x	0.7	=	80.01	(80)
West	0.9x	0.77	x	13.47	x	16.15	x	0.5	x	0.7	=	52.77	(80)

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

(83)m=	90.66	176.79	292.41	432.5	538.02	554.91	526.55	446.5	341.69	209.87	112.88	74.7	(83)

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

(84)m=	557.25	641.18	741.46	856.68	936.69	929.15	885.02	811.33	719.37	612.66	544.55	528.27	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.96	0.93	0.87	0.77	0.63	0.5	0.55	0.75	0.91	0.96	0.98	(86)

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

(87)m=	18.53	18.78	19.25	19.87	20.4	20.76	20.91	20.88	20.58	19.88	19.1	18.49	(87)

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

(88)m=	19.96	19.96	19.96	19.98	19.98	19.99	19.99	20	19.99	19.98	19.98	19.97	(88)

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

(89)m=	0.97	0.95	0.92	0.85	0.73	0.56	0.4	0.45	0.7	0.89	0.95	0.97	(89)

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

(90)m=	16.64	17.02	17.69	18.58	19.3	19.77	19.93	19.91	19.56	18.62	17.49	16.59	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	17.12	17.47	18.09	18.91	19.58	20.02	20.18	20.16	19.82	18.94	17.9	17.07	(92)

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

(93)m=	17.12	17.47	18.09	18.91	19.58	20.02	20.18	20.16	19.82	18.94	17.9	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=	0.95	0.93	0.89	0.82	0.71	0.56	0.42	0.47	0.69	0.86	0.93	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	529.63	596.82	661.64	701.79	664.1	521.55	372.67	381.06	493.17	526.74	507.44	504.99	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1489.66	1456.13	1339.08	1139.57	894.93	606.96	400.6	418.99	644.13	946.78	1233.7	1478.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	714.26	577.46	504.01	315.2	171.74	0	0	0	0	312.5	522.91	724.43	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3842.52 (98)

Space heating requirement in kWh/m²/year 38.07 (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	1051.75	827.97	847.84	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.77	0.83	0.8	0	0	0	0	(101)

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Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	807.78	685.59	676.61	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	1180.34	1126.78	1042.12	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	268.24	328.24	271.94	0	0	0	0

Total = Sum(104) = 868.42 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.6 (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) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	40.03	48.98	40.58	0	0	0	0

Total = Sum(107) = 129.59 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.28 (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		3842.52	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	4034.64	(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		2101.62	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2206.7	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	62.41	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	19.67	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		263.68	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)

Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =			263.68	(331)
Energy for lighting (calculated in Appendix L)				406.91	(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				93.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1441.85	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	32.39	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1474.24	(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) =				1474.24	(376)
CO2 associated with space cooling	(315) x		0.52	=	10.21	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	136.85	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	211.19	(379)
Total CO2, kg/year	sum of (376)…(382) =				1832.49	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				18.16	(384)
EI rating (section 14)					83.17	(385)

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User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Townhouse 1

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	39.87	(1a)	x	2.7	(2a)	=	107.65	(3a)
First floor	34.85	(1b)	x	3	(2b)	=	104.55	(3b)
Second floor	26.2	(1c)	x	2.9	(2c)	=	75.98	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	100.92	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	288.18	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.14	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(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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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

0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(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			2.43	x	1	=	2.43			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			4.6	x1/[1/(1.4)+ 0.04]		=	6.1			(27)
Windows Type 2			2.75	x1/[1/(1.4)+ 0.04]		=	3.65			(27)
Windows Type 3			12.7	x1/[1/(1.4)+ 0.04]		=	16.84			(27)
Floor			39.87	x	0.13	=	5.1831			(28)
Walls	172.41	25.22	147.19	x	0.18	=	26.49			(29)
Roof	39.87	0	39.87	x	0.13	=	5.18			(30)
Total area of elements, m²			252.15							(31)
Party wall			37.81	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) = 68.61 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7561.39 (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 26.76 (36)

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

Total fabric heat loss (33) + (36) = 95.37 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.55	57.16	56.78	54.99	54.66	53.1	53.1	52.81	53.7	54.66	55.33	56.04	(38)

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

(39)m=	152.92	152.53	152.15	150.36	150.02	148.47	148.47	148.18	149.07	150.02	150.7	151.41	

Average = $Sum(39)_{1...12}$ /12= 150.36 (39)

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

(40)m=	1.52	1.51	1.51	1.49	1.49	1.47	1.47	1.47	1.48	1.49	1.49	1.5

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 2.75 (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 99.46 (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=	109.41	105.43	101.45	97.47	93.49	89.52	89.52	93.49	97.47	101.45	105.43	109.41	

Total = $Sum(44)_{1...12}$ = 1193.55 (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=	162.25	141.9	146.43	127.66	122.5	105.7	97.95	112.4	113.74	132.56	144.7	157.13

Total = $Sum(45)_{1...12}$ = 1564.93 (45)

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

(46)m=	24.34	21.29	21.96	19.15	18.37	15.86	14.69	16.86	17.06	19.88	21.7	23.57	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.84 (55)

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	211.49	186.38	195.68	175.32	171.74	153.36	147.19	161.64	161.4	181.8	192.35	206.37	(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=	211.49	186.38	195.68	175.32	171.74	153.36	147.19	161.64	161.4	181.8	192.35	206.37

Output from water heater (annual)$_{1…12}$ — 2144.72 (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=	93.34	82.77	88.08	80.57	80.12	73.27	71.96	76.77	75.94	83.47	86.23	91.64	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	(66)

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

(67)m=	23.16	20.57	16.73	12.67	9.47	7.99	8.64	11.23	15.07	19.13	22.33	23.81	(67)

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

(68)m=	257.81	260.48	253.74	239.39	221.27	204.24	192.87	190.19	196.94	211.29	229.4	246.43	(68)

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

(69)m=	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	(71)

Water heating gains (Table 5)

(72)m=	125.46	123.16	118.39	111.9	107.69	101.76	96.72	103.18	105.48	112.19	119.77	123.17	(72)

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

(73)m=	473.65	471.43	456.08	431.18	405.65	381.22	365.45	371.82	384.7	409.83	438.72	460.63	(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	0.77	x	4.6	x	10.63	x	0.63	x	0.7	=	14.95	(74)
North	0.9x	0.77	x	4.6	x	20.32	x	0.63	x	0.7	=	28.57	(74)
North	0.9x	0.77	x	4.6	x	34.53	x	0.63	x	0.7	=	48.54	(74)
North	0.9x	0.77	x	4.6	x	55.46	x	0.63	x	0.7	=	77.97	(74)
North	0.9x	0.77	x	4.6	x	74.72	x	0.63	x	0.7	=	105.04	(74)
North	0.9x	0.77	x	4.6	x	79.99	x	0.63	x	0.7	=	112.44	(74)
North	0.9x	0.77	x	4.6	x	74.68	x	0.63	x	0.7	=	104.98	(74)
North	0.9x	0.77	x	4.6	x	59.25	x	0.63	x	0.7	=	83.29	(74)
North	0.9x	0.77	x	4.6	x	41.52	x	0.63	x	0.7	=	58.36	(74)
North	0.9x	0.77	x	4.6	x	24.19	x	0.63	x	0.7	=	34.01	(74)
North	0.9x	0.77	x	4.6	x	13.12	x	0.63	x	0.7	=	18.44	(74)
North	0.9x	0.77	x	4.6	x	8.86	x	0.63	x	0.7	=	12.46	(74)
East	0.9x	0.77	x	2.75	x	19.64	x	0.63	x	0.7	=	16.51	(76)
East	0.9x	0.77	x	2.75	x	38.42	x	0.63	x	0.7	=	32.29	(76)
East	0.9x	0.77	x	2.75	x	63.27	x	0.63	x	0.7	=	53.18	(76)
East	0.9x	0.77	x	2.75	x	92.28	x	0.63	x	0.7	=	77.56	(76)
East	0.9x	0.77	x	2.75	x	113.09	x	0.63	x	0.7	=	95.05	(76)
East	0.9x	0.77	x	2.75	x	115.77	x	0.63	x	0.7	=	97.3	(76)
East	0.9x	0.77	x	2.75	x	110.22	x	0.63	x	0.7	=	92.63	(76)
East	0.9x	0.77	x	2.75	x	94.68	x	0.63	x	0.7	=	79.57	(76)
East	0.9x	0.77	x	2.75	x	73.59	x	0.63	x	0.7	=	61.85	(76)
East	0.9x	0.77	x	2.75	x	45.59	x	0.63	x	0.7	=	38.31	(76)
East	0.9x	0.77	x	2.75	x	24.49	x	0.63	x	0.7	=	20.58	(76)
East	0.9x	0.77	x	2.75	x	16.15	x	0.63	x	0.7	=	13.57	(76)
West	0.9x	0.77	x	12.7	x	19.64	x	0.63	x	0.7	=	76.23	(80)
West	0.9x	0.77	x	12.7	x	38.42	x	0.63	x	0.7	=	149.12	(80)
West	0.9x	0.77	x	12.7	x	63.27	x	0.63	x	0.7	=	245.58	(80)
West	0.9x	0.77	x	12.7	x	92.28	x	0.63	x	0.7	=	358.17	(80)
West	0.9x	0.77	x	12.7	x	113.09	x	0.63	x	0.7	=	438.95	(80)
West	0.9x	0.77	x	12.7	x	115.77	x	0.63	x	0.7	=	449.34	(80)
West	0.9x	0.77	x	12.7	x	110.22	x	0.63	x	0.7	=	427.79	(80)
West	0.9x	0.77	x	12.7	x	94.68	x	0.63	x	0.7	=	367.46	(80)
West	0.9x	0.77	x	12.7	x	73.59	x	0.63	x	0.7	=	285.62	(80)
West	0.9x	0.77	x	12.7	x	45.59	x	0.63	x	0.7	=	176.94	(80)
West	0.9x	0.77	x	12.7	x	24.49	x	0.63	x	0.7	=	95.05	(80)
West	0.9x	0.77	x	12.7	x	16.15	x	0.63	x	0.7	=	62.69	(80)

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

(83)m=	107.68	209.98	347.3	513.69	639.03	659.08	625.4	530.32	405.83	249.27	134.07	88.72	(83)

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

(84)m=	581.33	681.41	803.38	944.87	1044.68	1040.3	990.85	902.14	790.53	659.09	572.8	549.35	(84)

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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	0.97	0.9	0.77	0.61	0.68	0.89	0.98	1	1	(86)

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

(87)m=	19.28	19.45	19.77	20.21	20.6	20.87	20.96	20.94	20.72	20.2	19.67	19.25	(87)

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

(88)m=	19.68	19.68	19.68	19.7	19.7	19.71	19.71	19.71	19.7	19.7	19.69	19.69	(88)

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

(89)m=	1	0.99	0.99	0.95	0.86	0.66	0.46	0.52	0.83	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=	17.41	17.66	18.13	18.77	19.3	19.62	19.7	19.69	19.47	18.77	17.99	17.39	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	17.89	18.12	18.55	19.13	19.64	19.94	20.02	20.01	19.79	19.13	18.42	17.86	(92)

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

(93)m=	17.89	18.12	18.55	19.13	19.64	19.94	20.02	20.01	19.79	19.13	18.42	17.86	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.85	0.68	0.5	0.56	0.83	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	578.94	675.89	787.43	891.21	891.34	711.46	491.55	507.91	658.05	637.55	568.44	547.56	(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=	2077.84	2016.16	1832.81	1538.65	1190.56	792.55	507.5	534.46	848.03	1280.28	1705.44	2068.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1115.18	900.66	777.77	466.15	222.62	0	0	0	0	478.19	818.64	1131.63	

Total per year (kWh/year) = Sum(98)1...5,9...12 = | 5910.84 | (98)

Space heating requirement in kWh/m²/year | 58.57 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1115.18	900.66	777.77	466.15	222.62	0	0	0	0	478.19	818.64	1131.63		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1192.71	963.27	831.84	498.56	238.1	0	0	0	0	511.44	875.55	1210.29		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													6321.75	(211)
Space heating fuel (secondary), kWh/month														
= {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)
Water heating														
Output from water heater (calculated above)														
	211.49	186.38	195.68	175.32	171.74	153.36	147.19	161.64	161.4	181.8	192.35	206.37		
Efficiency of water heater													79.8	(216)
(217)m=	88.61	88.47	88.12	87.3	85.51	79.8	79.8	79.8	79.8	87.28	88.25	88.67		(217)
Fuel for water heating, kWh/month														
(219)m = (64)m x 100 ÷ (217)m														
(219)m=	238.69	210.68	222.04	200.82	200.85	192.18	184.45	202.56	202.25	208.3	217.96	232.75		
Total = Sum(219a)$_{1...12}$ =													2513.54	(219)

Annual totals **kWh/year** **kWh/year**

Space heating fuel used, main system 1			6321.75	
Water heating fuel used			2513.54	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			409.05	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1365.5	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	542.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1908.42	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	212.3	(268)
Total CO2, kg/year			sum of (265)…(271) =		2159.64	(272)

TER =	21.4	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 05

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

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

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

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

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

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

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

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

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

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

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

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

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			2.68	x	1	=	2.68			(26)
Windows Type 1			5.74	x1/[1/(1.3)+ 0.04]		=	7.09			(27)
Windows Type 2			6.05	x1/[1/(1.3)+ 0.04]		=	7.48			(27)
Floor			71.42	x	0.11	=	7.8562			(28)
Walls Type1	60.25	14.47	45.78	x	0.15	=	6.87			(29)
Walls Type2	18.42	0	18.42	x	0.13	=	2.43			(29)
Total area of elements, m²			150.09							(31)
Party wall			19.66	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) = 34.41 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 9148.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 11.24 (36)

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

Total fabric heat loss (33) + (36) = 45.65 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.81	18.6	18.38	17.31	17.1	16.03	16.03	15.81	16.46	17.1	17.53	17.96	(38)

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

(39)m=	64.46	64.24	64.03	62.96	62.75	61.67	61.67	61.46	62.1	62.75	63.17	63.6	

Average = Sum(39)$_{1…12}$ /12= 62.91 (39)

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

(40)m=	0.9	0.9	0.9	0.88	0.88	0.86	0.86	0.86	0.87	0.88	0.88	0.89

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

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1...12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1...12}$ = 1390.13 (45)

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

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.72 (55)

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

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	

Output from water heater (annual)$_{1...12}$ 1926.82 (64)

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

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	18.54	16.47	13.39	10.14	7.58	6.4	6.92	8.99	12.06	15.32	17.88	19.06	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)

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

(73)m=	389.76	387.73	375.17	354.98	334.59	314.89	302.08	307.81	318.17	338.55	361.94	379.39	(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)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.5	x	0.7	=	27.34	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.5	x	0.7	=	53.49	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.5	x	0.7	=	88.09	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.5	x	0.7	=	128.48	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.5	x	0.7	=	157.45	(76)

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East	0.9x	0.77	x	5.74	x	115.77	x	0.5	x	0.7	=	161.18	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.5	x	0.7	=	153.45	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.5	x	0.7	=	131.81	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.5	x	0.7	=	102.45	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.5	x	0.7	=	63.47	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.5	x	0.7	=	34.09	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.5	x	0.7	=	22.49	(76)
West	0.9x	0.77	x	6.05	x	19.64	x	0.5	x	0.7	=	28.82	(80)
West	0.9x	0.77	x	6.05	x	38.42	x	0.5	x	0.7	=	56.38	(80)
West	0.9x	0.77	x	6.05	x	63.27	x	0.5	x	0.7	=	92.85	(80)
West	0.9x	0.77	x	6.05	x	92.28	x	0.5	x	0.7	=	135.41	(80)
West	0.9x	0.77	x	6.05	x	113.09	x	0.5	x	0.7	=	165.96	(80)
West	0.9x	0.77	x	6.05	x	115.77	x	0.5	x	0.7	=	169.88	(80)
West	0.9x	0.77	x	6.05	x	110.22	x	0.5	x	0.7	=	161.74	(80)
West	0.9x	0.77	x	6.05	x	94.68	x	0.5	x	0.7	=	138.93	(80)
West	0.9x	0.77	x	6.05	x	73.59	x	0.5	x	0.7	=	107.99	(80)
West	0.9x	0.77	x	6.05	x	45.59	x	0.5	x	0.7	=	66.9	(80)
West	0.9x	0.77	x	6.05	x	24.49	x	0.5	x	0.7	=	35.94	(80)
West	0.9x	0.77	x	6.05	x	16.15	x	0.5	x	0.7	=	23.7	(80)

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

(83)m=	56.16	109.87	180.94	263.89	323.41	331.06	315.19	270.74	210.44	130.37	70.03	46.19	(83)

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

(84)m=	445.92	497.6	556.11	618.87	657.99	645.96	617.27	578.55	528.61	468.92	431.97	425.58	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.9	0.83	0.71	0.55	0.42	0.46	0.67	0.86	0.94	0.96	(86)

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

(87)m=	19.22	19.45	19.83	20.31	20.68	20.9	20.97	20.96	20.8	20.32	19.7	19.19	(87)

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

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

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

(89)m=	0.95	0.93	0.89	0.81	0.67	0.5	0.35	0.39	0.62	0.84	0.93	0.96	(89)

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

(90)m=	17.77	18.1	18.65	19.33	19.82	20.1	20.18	20.17	19.99	19.35	18.47	17.73	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	18.33	18.62	19.1	19.71	20.15	20.41	20.48	20.47	20.3	19.72	18.94	18.29	(92)

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

(93)m=	18.33	18.62	19.1	19.71	20.15	20.41	20.48	20.47	20.3	19.72	18.94	18.29	(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=	0.94	0.92	0.87	0.79	0.67	0.51	0.38	0.41	0.63	0.83	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.21	455.76	485.31	489.31	440.66	330.71	231.64	239.72	331.87	387.31	394.64	401.88	(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=	904.26	881.18	806.93	680.29	530.11	358.04	239.22	250.14	385	572.24	748.04	896.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	361.62	285.88	239.29	137.5	66.55	0	0	0	0	137.59	254.45	367.68	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1850.56 (98)

Space heating requirement in kWh/m²/year 25.91 (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	579.74	456.39	467.1	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	506.5	418.57	421.04	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	829.08	794.13	749.99	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	232.26	279.41	244.74	0	0	0	0	

Total = Sum(104)$_{6..8}$ = 756.4 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.74 (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	42.74	51.42	45.04	0	0	0	0

Total = Sum(107)$_{6..8}$ = 139.19 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.95 (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)

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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		1850.56	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1943.09	(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		1926.82	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	39.66	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	21.13	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		161.41	(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) =	161.41	(331)
Energy for lighting (calculated in Appendix L)		327.49	(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				93.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	916.27	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.58	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	936.85	(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) =				936.85	(376)
CO2 associated with space cooling	(315) x		0.52	=	10.97	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	83.77	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	169.97	(379)

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Total CO_2, kg/year	sum of (376)…(382) =	1201.56	(383)
Dwelling CO_2 Emission Rate	(383) ÷ (4) =	16.82	(384)
EI rating (section 14)		86.17	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 05

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

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

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

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.68	x	1	=	2.68			(26)
Windows Type 1			5.74	x1/[1/(1.4)+ 0.04]		=	7.61			(27)
Windows Type 2			6.05	x1/[1/(1.4)+ 0.04]		=	8.02			(27)
Floor			71.42	x	0.13	=	9.284599			(28)
Walls Type1	60.25	14.47	45.78	x	0.18	=	8.24			(29)
Walls Type2	18.42	0	18.42	x	0.18	=	3.32			(29)
Total area of elements, m²			150.09							(31)
Party wall			19.66	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) = 39.15 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 9148.2 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.02 (36)

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

Total fabric heat loss (33) + (36) = 47.18 (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=	39.81	39.57	39.34	38.22	38.01	37.04	37.04	36.86	37.42	38.01	38.43	38.88	(38)

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

(39)m=	86.99	86.75	86.51	85.4	85.19	84.22	84.22	84.04	84.59	85.19	85.61	86.05	

Average = Sum(39)$_{1…12}$ /12= 85.4 (39)

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

(40)m=	1.22	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.18	1.19	1.2	1.2

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

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

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.84 (55)

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)

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

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

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

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

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

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

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

(62)m=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82

Output from water heater (annual)$_{1...12}$ | 1969.92 | (64)

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

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	18.54	16.47	13.39	10.14	7.58	6.4	6.92	8.99	12.06	15.32	17.88	19.06	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)

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

(73)m=	396.69	394.66	382.1	361.92	341.52	321.83	309.01	314.74	325.1	345.49	368.88	386.33	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.63	x	0.7	=	34.45	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.63	x	0.7	=	67.4	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.63	x	0.7	=	110.99	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.63	x	0.7	=	161.88	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.63	x	0.7	=	198.39	(76)

East	0.9x	0.77	x	5.74	x	115.77	x	0.63	x	0.7	=	203.09	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.63	x	0.7	=	193.35	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.63	x	0.7	=	166.08	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.63	x	0.7	=	129.09	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.63	x	0.7	=	79.97	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.63	x	0.7	=	42.96	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.63	x	0.7	=	28.33	(76)
West	0.9x	0.77	x	6.05	x	19.64	x	0.63	x	0.7	=	36.31	(80)
West	0.9x	0.77	x	6.05	x	38.42	x	0.63	x	0.7	=	71.04	(80)
West	0.9x	0.77	x	6.05	x	63.27	x	0.63	x	0.7	=	116.99	(80)
West	0.9x	0.77	x	6.05	x	92.28	x	0.63	x	0.7	=	170.62	(80)
West	0.9x	0.77	x	6.05	x	113.09	x	0.63	x	0.7	=	209.1	(80)
West	0.9x	0.77	x	6.05	x	115.77	x	0.63	x	0.7	=	214.05	(80)
West	0.9x	0.77	x	6.05	x	110.22	x	0.63	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	6.05	x	94.68	x	0.63	x	0.7	=	175.05	(80)
West	0.9x	0.77	x	6.05	x	73.59	x	0.63	x	0.7	=	136.06	(80)
West	0.9x	0.77	x	6.05	x	45.59	x	0.63	x	0.7	=	84.29	(80)
West	0.9x	0.77	x	6.05	x	24.49	x	0.63	x	0.7	=	45.28	(80)
West	0.9x	0.77	x	6.05	x	16.15	x	0.63	x	0.7	=	29.86	(80)

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

(83)m=	70.77	138.44	227.98	332.5	407.49	417.14	397.14	341.13	265.16	164.27	88.24	58.2	(83)

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

(84)m=	467.46	533.1	610.09	694.42	749.02	738.97	706.15	655.88	590.26	509.75	457.12	444.52	(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	0.95	0.85	0.68	0.51	0.57	0.83	0.97	0.99	1	(86)

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

(87)m=	19.72	19.87	20.15	20.51	20.8	20.95	20.99	20.98	20.87	20.49	20.04	19.7	(87)

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

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

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

(89)m=	1	0.99	0.98	0.93	0.8	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

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

(90)m=	18.21	18.44	18.84	19.36	19.73	19.91	19.93	19.93	19.83	19.34	18.69	18.18	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	18.79	18.99	19.34	19.8	20.14	20.31	20.34	20.34	20.23	19.78	19.21	18.76	(92)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.79	18.99	19.34	19.8	20.14	20.31	20.34	20.34	20.23	19.78	19.21	18.76		(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	0.93	0.81	0.62	0.44	0.5	0.77	0.95	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	464.94	527.5	594.32	642.87	608.7	458.75	311.56	325.06	456.32	485.85	452.31	442.62		(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=	1260.29	1222.07	1110.86	930.77	719.18	480.66	314.86	330.75	518.81	782.02	1036.64	1253.11		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	591.74	466.75	384.31	207.28	82.19	0	0	0	0	220.35	420.72	603.01		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2976.35	(98)
Space heating requirement in kWh/m²/year													41.67	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)														
	591.74	466.75	384.31	207.28	82.19	0	0	0	0	220.35	420.72	603.01		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	632.88	499.2	411.02	221.69	87.91	0	0	0	0	235.67	449.97	644.93		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3183.26	(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)														
	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82		
Efficiency of water heater													79.8	(216)
(217)m=	87.61	87.37	86.8	85.49	83.16	79.8	79.8	79.8	79.8	85.55	87.05	87.7		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	220.72	195.19	206.6	188.4	190.05	177.38	170.74	186.83	186.33	195.19	202.39	215.31		
Total = Sum(219a)$_{1...12}$ =													2335.14	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3183.26

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Water heating fuel used			2335.14	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.49	(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	=	687.58	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	504.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1191.97	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	169.97	(268)
Total CO2, kg/year			sum of (265)…(271) =		1400.87	(272)

TER = 19.61 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 13

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		203.55	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			2.12	x	1	=	2.12			(26)
Windows Type 1			5.74	x1/[1/(1.3)+ 0.04]		=	7.09			(27)
Windows Type 2			13.09	x1/[1/(1.3)+ 0.04]		=	16.18			(27)
Floor			71.42	x	0.11	=	7.8562			(28)
Walls Type1	60.25	18.83	41.42	x	0.15	=	6.21			(29)
Walls Type2	10.57	2.12	8.45	x	0.14	=	1.19			(29)
Walls Type3	7.84	0	7.84	x	0.13	=	1.04			(29)
Total area of elements, m²			150.08							(31)
Party wall			19.66	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) = 41.69 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6557.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 12.91 (36)

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

Total fabric heat loss (33) + (36) = 54.59 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.81	18.6	18.38	17.31	17.1	16.03	16.03	15.81	16.46	17.1	17.53	17.96	(38)

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

(39)m=	73.41	73.19	72.98	71.91	71.69	70.62	70.62	70.41	71.05	71.69	72.12	72.55	

Average = $Sum(39)_{1…12}$ /12= 71.85 (39)

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

(40)m=	1.03	1.02	1.02	1.01	1	0.99	0.99	0.99	0.99	1	1.01	1.02

Average = Sum(40)$_{1…12}$ /12= 1.01 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19	
										Total = Sum(44)$_{1…12}$ =		1060.23	(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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58	
										Total = Sum(45)$_{1…12}$ =		1390.13	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.72 (55)

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

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

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

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

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

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

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

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

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

(62)m=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	

Output from water heater (annual)$_{1...12}$ 1926.82 (64)

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

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	17.88	15.88	12.92	9.78	7.31	6.17	6.67	8.67	11.63	14.77	17.24	18.38	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)

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

(73)m=	389.1	387.14	374.69	354.62	334.32	314.66	301.83	307.49	317.74	338	361.3	378.71	(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)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.5	x	0.7	=	27.34	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.5	x	0.7	=	53.49	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.5	x	0.7	=	88.09	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.5	x	0.7	=	128.48	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.5	x	0.7	=	157.45	(76)

East	0.9x	0.77	x	5.74	x	115.77	x	0.5	x	0.7	=	161.18	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.5	x	0.7	=	153.45	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.5	x	0.7	=	131.81	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.5	x	0.7	=	102.45	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.5	x	0.7	=	63.47	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.5	x	0.7	=	34.09	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.5	x	0.7	=	22.49	(76)
West	0.9x	0.77	x	13.09	x	19.64	x	0.5	x	0.7	=	62.36	(80)
West	0.9x	0.77	x	13.09	x	38.42	x	0.5	x	0.7	=	121.98	(80)
West	0.9x	0.77	x	13.09	x	63.27	x	0.5	x	0.7	=	200.89	(80)
West	0.9x	0.77	x	13.09	x	92.28	x	0.5	x	0.7	=	292.99	(80)
West	0.9x	0.77	x	13.09	x	113.09	x	0.5	x	0.7	=	359.07	(80)
West	0.9x	0.77	x	13.09	x	115.77	x	0.5	x	0.7	=	367.57	(80)
West	0.9x	0.77	x	13.09	x	110.22	x	0.5	x	0.7	=	349.94	(80)
West	0.9x	0.77	x	13.09	x	94.68	x	0.5	x	0.7	=	300.59	(80)
West	0.9x	0.77	x	13.09	x	73.59	x	0.5	x	0.7	=	233.64	(80)
West	0.9x	0.77	x	13.09	x	45.59	x	0.5	x	0.7	=	144.74	(80)
West	0.9x	0.77	x	13.09	x	24.49	x	0.5	x	0.7	=	77.75	(80)
West	0.9x	0.77	x	13.09	x	16.15	x	0.5	x	0.7	=	51.28	(80)

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

(83)m=	89.7	175.47	288.98	421.46	516.52	528.75	503.39	432.41	336.1	208.22	111.85	73.77	(83)

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

(84)m=	478.8	562.61	663.67	776.09	850.84	843.41	805.22	739.89	653.83	546.22	473.15	452.48	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.95	0.93	0.88	0.78	0.64	0.49	0.37	0.41	0.63	0.84	0.93	0.96	(86)

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

(87)m=	18.99	19.29	19.76	20.3	20.69	20.9	20.97	20.95	20.79	20.25	19.53	18.94	(87)

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

(88)m=	20.06	20.06	20.07	20.08	20.08	20.09	20.09	20.1	20.09	20.08	20.08	20.07	(88)

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

(89)m=	0.95	0.92	0.86	0.75	0.6	0.43	0.3	0.34	0.57	0.81	0.92	0.96	(89)

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

(90)m=	17.37	17.8	18.47	19.23	19.74	20	20.07	20.06	19.88	19.17	18.15	17.31	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	18.19	18.55	19.12	19.77	20.22	20.45	20.52	20.51	20.34	19.72	18.85	18.13	(92)

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

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(93)m=	18.19	18.55	19.12	19.77	20.22	20.45	20.52	20.51	20.34	19.72	18.85	18.13	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.93	0.9	0.84	0.74	0.61	0.46	0.33	0.37	0.59	0.8	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	446.42	507.36	560.18	576.03	517.51	384.39	268.39	277.35	382.83	438.15	428.24	425.38	(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=	1019.57	998.96	920.8	781.76	610.58	413.4	277.01	289.51	443.22	653.52	847.09	1010.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	426.43	330.36	268.3	148.12	69.25	0	0	0	0	160.24	301.57	435.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2139.81 (98)

Space heating requirement in kWh/m²/year 29.96 (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	663.86	522.61	535.11	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.88	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	586.49	481.71	483.6	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1059.57	1013.49	938.14	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	340.62	395.64	338.18	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 1074.45 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.86 (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	73.52	85.39	72.99	0	0	0	0

Total = Sum(107)$_{6...8}$ = 231.9 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 3.25 (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)

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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		2139.81	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2246.8	(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		1926.82	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.7	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	35.2	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		161.41	(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) =	161.41	(331)
Energy for lighting (calculated in Appendix L)		315.81	(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			93.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	986.43	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	22.16	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	1008.59	(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) =			1008.59	(376)
CO2 associated with space cooling	(315) x	0.52	=	18.27	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	83.77	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	163.91	(379)

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Total CO2, kg/year	sum of (376)…(382) =	1274.54	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	17.85	(384)
EI rating (section 14)		85.33	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 13

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	71.42	(1a)	x	2.85	(2a)	=	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			203.55	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

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

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

Infiltration rate modified for monthly wind speed

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

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1	=	2.12			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			10.94	x1/[1/(1.4)+ 0.04]		=	14.5			(27)
Floor			71.42	x	0.13	=	9.284599			(28)
Walls Type1	60.25	15.74	44.51	x	0.18	=	8.01			(29)
Walls Type2	10.57	2.12	8.45	x	0.18	=	1.52			(29)
Walls Type3	7.84	0	7.84	x	0.18	=	1.41			(29)
Total area of elements, m²			150.08							(31)
Party wall			19.66	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) = 43.22 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6600.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 11.77 (36)

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

Total fabric heat loss (33) + (36) = 54.98 (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=	39.81	39.57	39.34	38.22	38.01	37.04	37.04	36.86	37.42	38.01	38.43	38.88	(38)

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

(39)m=	94.8	94.55	94.32	93.2	93	92.03	92.03	91.85	92.4	93	93.42	93.86	

Average = Sum(39)$_{1…12}$ /12= 93.2 (39)

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

(40)m=	1.33	1.32	1.32	1.31	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = Sum(40)$_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.28 (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 — 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

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

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.84 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0.84 (55)

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)

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

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

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

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

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

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

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

(62)m=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	

Output from water heater (annual)$_{1...12}$ 1969.92 (64)

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

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.89	15.89	12.92	9.78	7.31	6.17	6.67	8.67	11.64	14.78	17.25	18.38	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)
Water heating gains (Table 5)													
(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	396.04	394.08	381.63	361.56	341.25	321.6	308.77	314.42	324.68	344.94	368.24	385.65	(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)	
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)

East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)
West	0.9x	0.77	x	10.94	x	19.64	x	0.63	x	0.7	=	65.67	(80)
West	0.9x	0.77	x	10.94	x	38.42	x	0.63	x	0.7	=	128.46	(80)
West	0.9x	0.77	x	10.94	x	63.27	x	0.63	x	0.7	=	211.55	(80)
West	0.9x	0.77	x	10.94	x	92.28	x	0.63	x	0.7	=	308.53	(80)
West	0.9x	0.77	x	10.94	x	113.09	x	0.63	x	0.7	=	378.11	(80)
West	0.9x	0.77	x	10.94	x	115.77	x	0.63	x	0.7	=	387.07	(80)
West	0.9x	0.77	x	10.94	x	110.22	x	0.63	x	0.7	=	368.5	(80)
West	0.9x	0.77	x	10.94	x	94.68	x	0.63	x	0.7	=	316.54	(80)
West	0.9x	0.77	x	10.94	x	73.59	x	0.63	x	0.7	=	246.04	(80)
West	0.9x	0.77	x	10.94	x	45.59	x	0.63	x	0.7	=	152.42	(80)
West	0.9x	0.77	x	10.94	x	24.49	x	0.63	x	0.7	=	81.88	(80)
West	0.9x	0.77	x	10.94	x	16.15	x	0.63	x	0.7	=	54	(80)

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

(83)m=	94.48	184.82	304.37	443.9	544.02	556.9	530.19	455.42	353.99	219.3	117.8	77.69	(83)

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

(84)m=	490.51	578.89	685.99	805.46	885.27	878.5	838.96	769.85	678.67	564.24	486.04	463.35	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.81	0.63	0.47	0.53	0.79	0.96	0.99	1	(86)

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

(87)m=	19.61	19.79	20.11	20.51	20.81	20.96	20.99	20.98	20.87	20.46	19.96	19.58	(87)

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

(88)m=	19.82	19.82	19.82	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.83	19.83	(88)

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

(89)m=	1	0.99	0.97	0.9	0.75	0.53	0.35	0.41	0.71	0.94	0.99	1	(89)

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

(90)m=	17.99	18.26	18.72	19.29	19.67	19.82	19.85	19.85	19.75	19.23	18.51	17.95	(90)

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

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

(92)m=	18.8	19.03	19.42	19.91	20.24	20.39	20.42	20.42	20.32	19.85	19.24	18.77	(92)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.8	19.03	19.42	19.91	20.24	20.39	20.42	20.42	20.32	19.85	19.24	18.77		(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	0.9	0.77	0.58	0.41	0.47	0.75	0.94	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	487.41	571.19	662.49	727.45	684.34	510.68	348.07	362.57	506.56	532.77	480.06	461.05		(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=	1374.83	1336.17	1218.7	1025.75	794.52	533.21	351.87	369.22	574.49	860	1133.99	1367.55		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	660.24	514.07	413.82	214.78	81.97	0	0	0	0	243.46	470.83	674.44		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													3273.61	(98)
Space heating requirement in kWh/m²/year													45.84	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)														
	660.24	514.07	413.82	214.78	81.97	0	0	0	0	243.46	470.83	674.44		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	706.14	549.81	442.59	229.71	87.67	0	0	0	0	260.39	503.57	721.32		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3501.19	(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)														
	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82		
Efficiency of water heater													79.8	(216)
(217)m=	87.83	87.57	86.97	85.58	83.16	79.8	79.8	79.8	79.8	85.82	87.31	87.92		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	220.16	194.73	206.17	188.19	190.07	177.38	170.74	186.83	186.33	194.59	201.79	214.76		
Total = Sum(219a)$_{1...12}$ =													2331.74	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3501.19

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Water heating fuel used			2331.74	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			315.9	(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	=	756.26	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	503.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1259.91	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	163.95	(268)
Total CO2, kg/year			sum of (265)…(271) =		1462.79	(272)

TER = 20.48 (273)

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User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 24

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

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

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(21)

Infiltration rate modified for monthly wind speed

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

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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			2.68	x	1	=	2.68			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			4.16	x1/[1/(1.3)+ 0.04]		=	5.14			(27)
Windows Type 2			6.05	x1/[1/(1.3)+ 0.04]		=	7.48			(27)
Windows Type 3			2.85	x1/[1/(1.3)+ 0.04]		=	3.52			(27)
Floor			71.42	x	0.11	=	7.8562			(28)
Walls Type1	79.91	18.48	61.43	x	0.15	=	9.21			(29)
Walls Type2	18.41	0	18.41	x	0.13	=	2.43			(29)
Total area of elements, m²			169.74							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.06 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8973.96 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 12.3 (36)

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

Total fabric heat loss (33) + (36) = 53.36 (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=	19.78	19.54	19.31	18.14	17.91	16.75	16.75	16.51	17.21	17.91	18.38	18.84	(38)

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

(39)m=	73.14	72.91	72.67	71.51	71.27	70.11	70.11	69.88	70.58	71.27	71.74	72.21	

Average = Sum(39)$_{1…12}$ /12= 71.45 (39)

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

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

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

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19	
										Total = Sum(44)$_{1…12}$ =		1060.23	(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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58	
										Total = Sum(45)$_{1…12}$ =		1390.13	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.72 (55)

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

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

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

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

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

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

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

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

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

(62)m=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	

Output from water heater (annual)$_{1...12}$ 1926.82 (64)

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

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	18.22	16.18	13.16	9.96	7.45	6.29	6.79	8.83	11.85	15.05	17.57	18.73	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)

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

(73)m=	389.43	387.44	374.93	354.81	334.45	314.78	301.96	307.65	317.96	338.28	361.63	379.06	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.5	x	0.7	=	19.82	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.5	x	0.7	=	38.77	(76)
East	0.9x	0.77	x	4.16	x	63.27	x	0.5	x	0.7	=	63.84	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.5	x	0.7	=	93.11	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.5	x	0.7	=	114.11	(76)

East	0.9x	0.77	x	4.16	x	115.77	x	0.5	x	0.7	=	116.81	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.5	x	0.7	=	111.21	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.5	x	0.7	=	95.53	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.5	x	0.7	=	74.25	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.5	x	0.7	=	46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.5	x	0.7	=	24.71	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.5	x	0.7	=	16.3	(76)
South	0.9x	0.77	x	2.85	x	46.75	x	0.5	x	0.7	=	32.32	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.5	x	0.7	=	52.93	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.5	x	0.7	=	67.42	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.5	x	0.7	=	76.2	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.5	x	0.7	=	79.41	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.5	x	0.7	=	76.42	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.5	x	0.7	=	74.67	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.5	x	0.7	=	72.51	(78)
South	0.9x	0.77	x	2.85	x	101.89	x	0.5	x	0.7	=	70.43	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.5	x	0.7	=	57.09	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.5	x	0.7	=	38.31	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.5	x	0.7	=	27.93	(78)
West	0.9x	0.77	x	6.05	x	19.64	x	0.5	x	0.7	=	28.82	(80)
West	0.9x	0.77	x	6.05	x	38.42	x	0.5	x	0.7	=	56.38	(80)
West	0.9x	0.77	x	6.05	x	63.27	x	0.5	x	0.7	=	92.85	(80)
West	0.9x	0.77	x	6.05	x	92.28	x	0.5	x	0.7	=	135.41	(80)
West	0.9x	0.77	x	6.05	x	113.09	x	0.5	x	0.7	=	165.96	(80)
West	0.9x	0.77	x	6.05	x	115.77	x	0.5	x	0.7	=	169.88	(80)
West	0.9x	0.77	x	6.05	x	110.22	x	0.5	x	0.7	=	161.74	(80)
West	0.9x	0.77	x	6.05	x	94.68	x	0.5	x	0.7	=	138.93	(80)
West	0.9x	0.77	x	6.05	x	73.59	x	0.5	x	0.7	=	107.99	(80)
West	0.9x	0.77	x	6.05	x	45.59	x	0.5	x	0.7	=	66.9	(80)
West	0.9x	0.77	x	6.05	x	24.49	x	0.5	x	0.7	=	35.94	(80)
West	0.9x	0.77	x	6.05	x	16.15	x	0.5	x	0.7	=	23.7	(80)

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

(83)m=	80.96	148.07	224.11	304.73	359.47	363.12	347.61	306.97	252.67	169.99	98.95	67.92	(83)

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

(84)m=	470.39	535.51	599.05	659.53	693.93	677.9	649.57	614.62	570.62	508.27	460.58	446.98	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.9	0.83	0.72	0.58	0.44	0.48	0.68	0.86	0.94	0.96	(86)

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

(87)m=	18.98	19.24	19.65	20.16	20.58	20.85	20.95	20.93	20.74	20.2	19.51	18.94	(87)

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

(88)m=	20.06	20.07	20.07	20.08	20.09	20.1	20.1	20.1	20.09	20.09	20.08	20.07	(88)

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

(89)m=	0.95	0.93	0.89	0.81	0.68	0.51	0.36	0.4	0.62	0.84	0.93	0.96	(89)

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

(90)m=	17.36	17.73	18.32	19.05	19.61	19.96	20.06	20.05	19.83	19.11	18.13	17.31	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	17.98	18.31	18.83	19.48	19.98	20.3	20.4	20.39	20.18	19.53	18.66	17.93	(92)

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

(93)m=	17.98	18.31	18.83	19.48	19.98	20.3	20.4	20.39	20.18	19.53	18.66	17.93	(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=	0.93	0.91	0.86	0.79	0.68	0.53	0.39	0.43	0.63	0.82	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	438.68	486.02	517.83	520.07	470.46	358.57	254.12	262.55	358.91	415.37	417.66	420	(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=	1000.68	977.71	896.22	756.27	590.03	399.45	266.52	278.77	429.06	636.37	829.44	991.71	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	418.13	330.41	281.52	170.07	88.96	0	0	0	0	164.43	296.48	425.35	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2175.35 (98)

Space heating requirement in kWh/m²/year 30.46 (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	659.03	518.81	531.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.83	0.89	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	549.61	459.33	461.27	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	866.26	831.72	791.94	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	227.99	277.06	246.02	0	0	0	0	

Total = Sum(104)6...8 = 751.07 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.74 (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	41.95	50.98	45.27	0	0	0	0

Total = Sum(107) = 138.21 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.94 (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		2175.35	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2284.12	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1926.82	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	43.07	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	20.98	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		161.41	(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) =	161.41	(331)
Energy for lighting (calculated in Appendix L)		321.76	(332)

12b. CO_2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
CO_2 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				93.5	(367a)
CO_2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	995.05	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	22.35	(372)

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Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	1017.41	(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) =			1017.41	(376)
CO2 associated with space cooling	(315) x	0.52	=	10.89	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	83.77	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	166.99	(379)
Total CO2, kg/year	sum of (376)…(382) =			1279.06	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			17.91	(384)
EI rating (section 14)				85.28	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 24

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

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

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

0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(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			2.68	x	1	=	2.68			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			3.96	x1/[1/(1.4)+ 0.04]		=	5.25			(27)
Windows Type 2			5.76	x1/[1/(1.4)+ 0.04]		=	7.64			(27)
Windows Type 3			2.71	x1/[1/(1.4)+ 0.04]		=	3.59			(27)
Floor			71.42	x	0.13	=	9.284599			(28)
Walls Type1	79.91	17.85	62.06	x	0.18	=	11.17			(29)
Walls Type2	18.41	0	18.41	x	0.18	=	3.31			(29)
Total area of elements, m²			169.74							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8982.78 (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 10.1 (36)

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

Total fabric heat loss (33) + (36) = 55.77 (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=	40.96	40.68	40.39	39.08	38.83	37.68	37.68	37.47	38.12	38.83	39.33	39.85	(38)

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

(39)m=	96.73	96.44	96.16	94.84	94.6	93.45	93.45	93.23	93.89	94.6	95.09	95.62	

Average = Sum(39)$_{1…12}$ /12= 94.84 (39)

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

(40)m=	1.35	1.35	1.35	1.33	1.32	1.31	1.31	1.31	1.31	1.32	1.33	1.34

Average = Sum(40)$_{1…12}$ /12= 1.33 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.28 (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 — 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19	
										Total = Sum(44)$_{1…12}$ =		1060.23	(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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58	
										Total = Sum(45)$_{1…12}$ =		1390.13	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.55 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0.84 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0.84 (55)

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)

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

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

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

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

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

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

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

(62)m=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	

Output from water heater (annual)$_{1...12}$ 1969.92 (64)

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

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	18.37	16.31	13.27	10.04	7.51	6.34	6.85	8.9	11.95	15.17	17.71	18.88	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)

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

(73)m=	396.52	394.5	381.97	361.82	341.45	321.77	308.95	314.66	324.99	345.34	368.71	386.14	(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)	
East	0.9x	0.77	x	3.96	x	19.64	x	0.63	x	0.7	=	23.77	(76)
East	0.9x	0.77	x	3.96	x	38.42	x	0.63	x	0.7	=	46.5	(76)
East	0.9x	0.77	x	3.96	x	63.27	x	0.63	x	0.7	=	76.57	(76)
East	0.9x	0.77	x	3.96	x	92.28	x	0.63	x	0.7	=	111.68	(76)
East	0.9x	0.77	x	3.96	x	113.09	x	0.63	x	0.7	=	136.87	(76)

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East	0.9x	0.77	x	3.96	x	115.77	x	0.63	x	0.7	=	140.11	(76)
East	0.9x	0.77	x	3.96	x	110.22	x	0.63	x	0.7	=	133.39	(76)
East	0.9x	0.77	x	3.96	x	94.68	x	0.63	x	0.7	=	114.58	(76)
East	0.9x	0.77	x	3.96	x	73.59	x	0.63	x	0.7	=	89.06	(76)
East	0.9x	0.77	x	3.96	x	45.59	x	0.63	x	0.7	=	55.17	(76)
East	0.9x	0.77	x	3.96	x	24.49	x	0.63	x	0.7	=	29.64	(76)
East	0.9x	0.77	x	3.96	x	16.15	x	0.63	x	0.7	=	19.55	(76)
South	0.9x	0.77	x	2.71	x	46.75	x	0.63	x	0.7	=	38.72	(78)
South	0.9x	0.77	x	2.71	x	76.57	x	0.63	x	0.7	=	63.41	(78)
South	0.9x	0.77	x	2.71	x	97.53	x	0.63	x	0.7	=	80.78	(78)
South	0.9x	0.77	x	2.71	x	110.23	x	0.63	x	0.7	=	91.3	(78)
South	0.9x	0.77	x	2.71	x	114.87	x	0.63	x	0.7	=	95.14	(78)
South	0.9x	0.77	x	2.71	x	110.55	x	0.63	x	0.7	=	91.56	(78)
South	0.9x	0.77	x	2.71	x	108.01	x	0.63	x	0.7	=	89.46	(78)
South	0.9x	0.77	x	2.71	x	104.89	x	0.63	x	0.7	=	86.87	(78)
South	0.9x	0.77	x	2.71	x	101.89	x	0.63	x	0.7	=	84.38	(78)
South	0.9x	0.77	x	2.71	x	82.59	x	0.63	x	0.7	=	68.4	(78)
South	0.9x	0.77	x	2.71	x	55.42	x	0.63	x	0.7	=	45.9	(78)
South	0.9x	0.77	x	2.71	x	40.4	x	0.63	x	0.7	=	33.46	(78)
West	0.9x	0.77	x	5.76	x	19.64	x	0.63	x	0.7	=	34.57	(80)
West	0.9x	0.77	x	5.76	x	38.42	x	0.63	x	0.7	=	67.63	(80)
West	0.9x	0.77	x	5.76	x	63.27	x	0.63	x	0.7	=	111.38	(80)
West	0.9x	0.77	x	5.76	x	92.28	x	0.63	x	0.7	=	162.44	(80)
West	0.9x	0.77	x	5.76	x	113.09	x	0.63	x	0.7	=	199.08	(80)
West	0.9x	0.77	x	5.76	x	115.77	x	0.63	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	5.76	x	110.22	x	0.63	x	0.7	=	194.02	(80)
West	0.9x	0.77	x	5.76	x	94.68	x	0.63	x	0.7	=	166.66	(80)
West	0.9x	0.77	x	5.76	x	73.59	x	0.63	x	0.7	=	129.54	(80)
West	0.9x	0.77	x	5.76	x	45.59	x	0.63	x	0.7	=	80.25	(80)
West	0.9x	0.77	x	5.76	x	24.49	x	0.63	x	0.7	=	43.11	(80)
West	0.9x	0.77	x	5.76	x	16.15	x	0.63	x	0.7	=	28.43	(80)

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

(83)m=	97.06	177.54	268.74	365.42	431.09	435.46	416.87	368.11	302.98	203.82	118.64	81.44	(83)

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

(84)m=	493.58	572.05	650.71	727.24	772.54	757.23	725.82	682.77	627.97	549.16	487.35	467.58	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.55	0.6	0.83	0.97	0.99	1	(86)

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

(87)m=	19.58	19.75	20.04	20.42	20.73	20.92	20.98	20.97	20.84	20.42	19.93	19.55	(87)

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

(88)m=	19.8	19.8	19.8	19.82	19.82	19.83	19.83	19.84	19.83	19.82	19.82	19.81	(88)

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

(89)m=	1	0.99	0.97	0.93	0.82	0.61	0.41	0.46	0.75	0.95	0.99	1	(89)

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

(90)m=	17.93	18.18	18.61	19.15	19.56	19.79	19.83	19.83	19.7	19.17	18.46	17.9	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	18.56	18.78	19.16	19.63	20.01	20.22	20.27	20.27	20.14	19.65	19.03	18.53	(92)

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

(93)m=	18.56	18.78	19.16	19.63	20.01	20.22	20.27	20.27	20.14	19.65	19.03	18.53	(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	0.92	0.83	0.65	0.46	0.51	0.77	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	490.19	564.39	631.26	672.7	637.47	490.1	336.88	350.85	486.56	519.84	480.95	465.02	(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=	1379.25	1339.02	1216.99	1018.04	786.28	525.37	343	360.46	567.08	855.95	1134.06	1370.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	661.47	520.55	435.79	248.65	110.71	0	0	0	0	250.07	470.24	673.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3371.06 (98)

Space heating requirement in kWh/m²/year 47.2 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	661.47	520.55	435.79	248.65	110.71	0	0	0	0	250.07	470.24	673.59	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	707.45	556.74	466.08	265.94	118.41	0	0	0	0	267.45	502.93	720.42	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3605.41 (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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Water heating

Output from water heater (calculated above)

193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82

Efficiency of water heater 79.8 (216)

(217)m=	87.84	87.6	87.1	85.97	83.89	79.8	79.8	79.8	79.8	85.89	87.31	87.92	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	220.15	194.67	205.89	187.34	188.42	177.38	170.74	186.83	186.33	194.43	201.8	214.77

Total = Sum(219a)$_{1...12}$ = 2328.74 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3605.41	
Water heating fuel used		2328.74	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		324.37	(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	=	778.77	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	503.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1281.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	168.35	(268)
Total CO2, kg/year		sum of (265)…(271) =		1489.05	(272)

TER = 20.85 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 33

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	2.75	(2a) =	136.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.62	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

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

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

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

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			2.12	x	1	=	2.12			(26)
Windows Type 1			3.16	x1/[1/(1.3)+ 0.04]		=	3.9			(27)
Windows Type 2			8.72	x1/[1/(1.3)+ 0.04]		=	10.78			(27)
Walls Type1	40.81	14	26.81	x	0.15	=	4.02			(29)
Walls Type2	10.2	0	10.2	x	0.14	=	1.44			(29)
Walls Type3	7.56	0	7.56	x	0.13	=	1			(29)
Roof	49.68	0	49.68	x	0.11	=	5.46			(30)
Total area of elements, m²			108.25							(31)
Party wall			18.97	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) = 28.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1450.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 10.06 (36)

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

Total fabric heat loss (33) + (36) = 38.78 (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=	12.63	12.48	12.34	11.62	11.48	10.76	10.76	10.61	11.05	11.48	11.76	12.05	(38)

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

(39)m=	51.41	51.27	51.12	50.4	50.26	49.54	49.54	49.4	49.83	50.26	50.55	50.83	

Average = Sum(39)$_{1…12}$ /12= 50.37 (39)

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

(40)m=	1.03	1.03	1.03	1.01	1.01	1	1	0.99	1	1.01	1.02	1.02

Average = Sum(40)$_{1…12}$ /12= 1.01 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.68 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 74.12 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Total = Sum(44)$_{1…12}$ = 889.39 (44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.2 (48)

Temperature factor from Table 2b — 0.6 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0.72 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

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

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

(62)m=	166.49	146.91	154.7	139.24	136.86	122.88	118.57	129.34	128.87	144.36	151.93	162.67	(62)

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

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

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

Output from water heater

(64)m=	166.49	146.91	154.7	139.24	136.86	122.88	118.57	129.34	128.87	144.36	151.93	162.67	

Output from water heater (annual)$_{1...12}$ 1702.83 (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=	76.67	68.1	72.75	66.92	66.82	61.48	60.74	64.32	63.47	69.31	71.14	75.4	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)

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

(67)m=	13.05	11.59	9.43	7.14	5.34	4.5	4.87	6.33	8.49	10.78	12.58	13.41	(67)

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

(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)

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

(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	103.05	101.33	97.78	92.95	89.81	85.39	81.63	86.45	88.15	93.16	98.81	101.34	(72)

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

(73)m=	310.71	309.06	299.51	284.24	269.01	254.09	244.24	248.99	256.69	272.14	289.87	302.91	(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)	
East	0.9x	0.77	x	3.16	x	19.64	x	0.5	x	0.7	=	15.05	(76)
East	0.9x	0.77	x	3.16	x	38.42	x	0.5	x	0.7	=	29.45	(76)
East	0.9x	0.77	x	3.16	x	63.27	x	0.5	x	0.7	=	48.5	(76)
East	0.9x	0.77	x	3.16	x	92.28	x	0.5	x	0.7	=	70.73	(76)
East	0.9x	0.77	x	3.16	x	113.09	x	0.5	x	0.7	=	86.68	(76)

East	0.9x	0.77	x	3.16	x	115.77	x	0.5	x	0.7	=	88.73	(76)
East	0.9x	0.77	x	3.16	x	110.22	x	0.5	x	0.7	=	84.48	(76)
East	0.9x	0.77	x	3.16	x	94.68	x	0.5	x	0.7	=	72.57	(76)
East	0.9x	0.77	x	3.16	x	73.59	x	0.5	x	0.7	=	56.4	(76)
East	0.9x	0.77	x	3.16	x	45.59	x	0.5	x	0.7	=	34.94	(76)
East	0.9x	0.77	x	3.16	x	24.49	x	0.5	x	0.7	=	18.77	(76)
East	0.9x	0.77	x	3.16	x	16.15	x	0.5	x	0.7	=	12.38	(76)
West	0.9x	0.77	x	8.72	x	19.64	x	0.5	x	0.7	=	41.54	(80)
West	0.9x	0.77	x	8.72	x	38.42	x	0.5	x	0.7	=	81.26	(80)
West	0.9x	0.77	x	8.72	x	63.27	x	0.5	x	0.7	=	133.82	(80)
West	0.9x	0.77	x	8.72	x	92.28	x	0.5	x	0.7	=	195.18	(80)
West	0.9x	0.77	x	8.72	x	113.09	x	0.5	x	0.7	=	239.2	(80)
West	0.9x	0.77	x	8.72	x	115.77	x	0.5	x	0.7	=	244.86	(80)
West	0.9x	0.77	x	8.72	x	110.22	x	0.5	x	0.7	=	233.12	(80)
West	0.9x	0.77	x	8.72	x	94.68	x	0.5	x	0.7	=	200.24	(80)
West	0.9x	0.77	x	8.72	x	73.59	x	0.5	x	0.7	=	155.64	(80)
West	0.9x	0.77	x	8.72	x	45.59	x	0.5	x	0.7	=	96.42	(80)
West	0.9x	0.77	x	8.72	x	24.49	x	0.5	x	0.7	=	51.8	(80)
West	0.9x	0.77	x	8.72	x	16.15	x	0.5	x	0.7	=	34.16	(80)

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

(83)m=	56.59	110.71	182.32	265.9	325.88	333.59	317.59	272.81	212.05	131.36	70.57	46.54	(83)

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

(84)m=	367.3	419.77	481.83	550.14	594.88	587.68	561.83	521.8	468.74	403.5	360.44	349.45	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.94	0.92	0.87	0.78	0.64	0.49	0.37	0.41	0.62	0.83	0.92	0.95	(86)

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

(87)m=	19.08	19.35	19.79	20.31	20.68	20.9	20.97	20.95	20.79	20.28	19.6	19.04	(87)

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

(88)m=	20.05	20.06	20.06	20.07	20.07	20.09	20.09	20.09	20.08	20.07	20.07	20.06	(88)

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

(89)m=	0.94	0.91	0.85	0.75	0.6	0.43	0.3	0.34	0.56	0.8	0.91	0.94	(89)

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

(90)m=	17.5	17.88	18.51	19.23	19.73	19.99	20.06	20.06	19.88	19.22	18.26	17.44	(90)

fLA = Living area ÷ (4) = 0.58 (91)

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

(92)m=	18.42	18.74	19.25	19.86	20.28	20.52	20.59	20.58	20.41	19.84	19.04	18.37	(92)

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

(93)m=	18.42	18.74	19.25	19.86	20.28	20.52	20.59	20.58	20.41	19.84	19.04	18.37	(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=	0.92	0.89	0.84	0.74	0.61	0.46	0.34	0.38	0.58	0.79	0.89	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	337.94	373.96	402.87	407.09	363.89	271.47	190.91	197.28	272.08	318.08	320.98	324.26	(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=	725.79	709.33	651.92	552.22	431.28	293.07	197.48	206.28	314.41	464.22	603.33	720.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	288.56	225.37	185.29	104.49	50.14	0	0	0	0	108.73	203.29	294.51	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1460.38 (98)

Space heating requirement in kWh/m²/year 29.4 (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	465.69	366.61	375.42	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.88	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	410.48	337.41	339.42	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	740.05	708.86	662.71	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	237.3	276.37	240.53	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 754.19 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.83 (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	49.21	57.31	49.88	0	0	0	0

Total = Sum(107)$_{6...8}$ = 156.4 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 3.15 (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)

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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		1460.38	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1533.4	(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		1702.83	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1787.97	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.21	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	23.74	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		108.34	(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) =	108.34	(331)
Energy for lighting (calculated in Appendix L)		230.5	(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				93.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	767.29	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	17.24	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	784.53	(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) =				784.53	(376)
CO2 associated with space cooling	(315) x		0.52	=	12.32	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	56.23	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	119.63	(379)

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Total CO2, kg/year	sum of (376)…(382) =	972.71	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	19.58	(384)
EI rating (section 14)		86.23	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 33

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	2.75	(2a) =	136.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.62	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

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

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

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1	=	2.12			(26)
Windows Type 1			2.74	x1/[1/(1.4)+ 0.04]		=	3.63			(27)
Windows Type 2			7.56	x1/[1/(1.4)+ 0.04]		=	10.02			(27)
Walls Type1	40.81	12.42	28.39	x	0.18	=	5.11			(29)
Walls Type2	10.2	0	10.2	x	0.18	=	1.84			(29)
Walls Type3	7.56	0	7.56	x	0.18	=	1.36			(29)
Roof	49.68	0	49.68	x	0.13	=	6.46			(30)
Total area of elements, m²			108.25							(31)
Party wall			18.97	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) = 30.54 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1472.62 (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 12.65 (36)

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

Total fabric heat loss (33) + (36) = 43.19 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	26.7	26.54	26.38	25.64	25.5	24.85	24.85	24.73	25.1	25.5	25.78	26.08	(38)

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

(39)m=	69.89	69.73	69.57	68.83	68.69	68.04	68.04	67.92	68.29	68.69	68.97	69.27	

Average = Sum(39)$_{1…12}$ /12= 68.83 (39)

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

(40)m=	1.41	1.4	1.4	1.39	1.38	1.37	1.37	1.37	1.37	1.38	1.39	1.39	

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.12 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53	

Total = Sum(44)$_{1…12}$ = 889.39 (44)

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

(45)m=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

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

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.84 (55)

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)

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

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

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

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

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

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

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

(62)m=	170.15	150.22	158.36	142.79	140.52	126.42	122.23	133	132.41	148.02	155.48	166.33	(62)

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

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

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

Output from water heater

(64)m=	170.15	150.22	158.36	142.79	140.52	126.42	122.23	133	132.41	148.02	155.48	166.33	

Output from water heater (annual)$_{1...12}$ 1745.93 (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=	79.59	70.74	75.68	69.75	69.74	64.31	63.66	67.24	66.31	72.24	73.97	78.33	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.1	11.64	9.46	7.16	5.36	4.52	4.89	6.35	8.52	10.82	12.63	13.46	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)
Water heating gains (Table 5)													
(72)m=	106.98	105.27	101.71	96.88	93.74	89.32	85.57	90.38	92.09	97.09	102.74	105.28	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	317.7	316.04	306.48	291.2	275.96	261.04	251.19	255.95	263.66	279.11	296.86	309.89	(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)	
East	0.9x	0.77	x	2.74	x	19.64	x	0.63	x	0.7	=	16.45	(76)
East	0.9x	0.77	x	2.74	x	38.42	x	0.63	x	0.7	=	32.17	(76)
East	0.9x	0.77	x	2.74	x	63.27	x	0.63	x	0.7	=	52.98	(76)
East	0.9x	0.77	x	2.74	x	92.28	x	0.63	x	0.7	=	77.27	(76)
East	0.9x	0.77	x	2.74	x	113.09	x	0.63	x	0.7	=	94.7	(76)

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East	0.9x	0.77	x	2.74	x	115.77	x	0.63	x	0.7	=	96.94	(76)
East	0.9x	0.77	x	2.74	x	110.22	x	0.63	x	0.7	=	92.29	(76)
East	0.9x	0.77	x	2.74	x	94.68	x	0.63	x	0.7	=	79.28	(76)
East	0.9x	0.77	x	2.74	x	73.59	x	0.63	x	0.7	=	61.62	(76)
East	0.9x	0.77	x	2.74	x	45.59	x	0.63	x	0.7	=	38.18	(76)
East	0.9x	0.77	x	2.74	x	24.49	x	0.63	x	0.7	=	20.51	(76)
East	0.9x	0.77	x	2.74	x	16.15	x	0.63	x	0.7	=	13.52	(76)
West	0.9x	0.77	x	7.56	x	19.64	x	0.63	x	0.7	=	45.38	(80)
West	0.9x	0.77	x	7.56	x	38.42	x	0.63	x	0.7	=	88.77	(80)
West	0.9x	0.77	x	7.56	x	63.27	x	0.63	x	0.7	=	146.19	(80)
West	0.9x	0.77	x	7.56	x	92.28	x	0.63	x	0.7	=	213.21	(80)
West	0.9x	0.77	x	7.56	x	113.09	x	0.63	x	0.7	=	261.29	(80)
West	0.9x	0.77	x	7.56	x	115.77	x	0.63	x	0.7	=	267.48	(80)
West	0.9x	0.77	x	7.56	x	110.22	x	0.63	x	0.7	=	254.65	(80)
West	0.9x	0.77	x	7.56	x	94.68	x	0.63	x	0.7	=	218.74	(80)
West	0.9x	0.77	x	7.56	x	73.59	x	0.63	x	0.7	=	170.02	(80)
West	0.9x	0.77	x	7.56	x	45.59	x	0.63	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	7.56	x	24.49	x	0.63	x	0.7	=	56.58	(80)
West	0.9x	0.77	x	7.56	x	16.15	x	0.63	x	0.7	=	37.32	(80)

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

(83)m=	61.82	120.94	199.17	290.48	355.99	364.42	346.95	298.02	231.65	143.51	77.09	50.84	(83)

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

(84)m=	379.52	436.98	505.65	581.68	631.96	625.47	598.14	553.97	495.3	422.62	373.94	360.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.82	0.65	0.49	0.54	0.79	0.96	0.99	1	(86)

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

(87)m=	19.57	19.75	20.07	20.47	20.78	20.94	20.99	20.98	20.86	20.44	19.93	19.54	(87)

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

(88)m=	19.76	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.77	(88)

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

(89)m=	0.99	0.99	0.96	0.9	0.76	0.54	0.36	0.41	0.7	0.93	0.99	0.99	(89)

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

(90)m=	17.9	18.16	18.61	19.18	19.57	19.75	19.78	19.78	19.68	19.15	18.43	17.86	(90)

fLA = Living area ÷ (4) = 0.58 (91)

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

(92)m=	18.87	19.08	19.46	19.92	20.27	20.44	20.48	20.48	20.36	19.9	19.3	18.84	(92)

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

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(93)m=	18.87	19.08	19.46	19.92	20.27	20.44	20.48	20.48	20.36	19.9	19.3	18.84	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.98	0.96	0.9	0.78	0.6	0.43	0.49	0.75	0.94	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	376.05	429.6	486.33	525.22	494.96	375.74	259.92	270.08	371.26	395.94	367.69	358.05		(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=	1018.33	989.02	901.36	758.82	588.84	397.55	264.07	276.85	427.65	638.63	841.65	1013.85		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	477.86	375.94	308.78	168.2	69.84	0	0	0	0	180.56	341.25	487.92		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2410.35	(98)
Space heating requirement in kWh/m²/year													48.52	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)														
	477.86	375.94	308.78	168.2	69.84	0	0	0	0	180.56	341.25	487.92		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	511.08	402.07	330.25	179.89	74.7	0	0	0	0	193.11	364.97	521.84		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2577.91	(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)														
	170.15	150.22	158.36	142.79	140.52	126.42	122.23	133	132.41	148.02	155.48	166.33		
Efficiency of water heater													79.8	(216)
(217)m=	87.42	87.16	86.57	85.25	83.06	79.8	79.8	79.8	79.8	85.34	86.85	87.52		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	194.63	172.34	182.94	167.49	169.18	158.42	153.17	166.67	165.93	173.44	179.01	190.06		
Total = Sum(219a)$_{1...12}$ =													2073.27	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2577.91

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Water heating fuel used			2073.27	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			231.36	(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	=	556.83	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	447.83	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1004.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	120.07	(268)
Total CO2, kg/year		sum of (265)…(271) =		1163.65	(272)

TER = 23.42 (273)

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User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 34

Address :	The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.75	(2a) =	196.4	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	196.4	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

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

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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			2.12	x	1	=	2.12			(26)
Windows Type 1			5.74	x1/[1/(1.3)+ 0.04]		=	7.09			(27)
Windows Type 2			14.71	x1/[1/(1.3)+ 0.04]		=	18.18			(27)
Windows Type 3			2.85	x1/[1/(1.3)+ 0.04]		=	3.52			(27)
Walls Type1	77.11	23.3	53.81	x	0.15	=	8.07			(29)
Walls Type2	10.2	2.12	8.08	x	0.14	=	1.14			(29)
Walls Type3	7.56	0	7.56	x	0.13	=	1			(29)
Roof	71.42	0	71.42	x	0.11	=	7.86			(30)
Total area of elements, m²			166.29							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.98 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1615.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 16.45 (36)

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

Total fabric heat loss (33) + (36) = 65.43 (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=	19.08	18.86	18.63	17.51	17.28	16.16	16.16	15.93	16.61	17.28	17.73	18.18	(38)

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

(39)m=	84.51	84.29	84.06	82.94	82.72	81.59	81.59	81.37	82.04	82.72	83.17	83.62

Average = Sum(39)$_{1…12}$ /12= 82.88 (39)

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

(40)m=	1.18	1.18	1.18	1.16	1.16	1.14	1.14	1.14	1.15	1.16	1.16	1.17

Average = Sum(40)$_{1...12}$ /12= 1.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19	
Total = Sum(44)$_{1...12}$ =												1060.23	(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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58	
Total = Sum(45)$_{1...12}$ =												1390.13	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.72 (55)

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

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

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

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

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

(62)m=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	

Output from water heater (annual)$_{1...12}$ 1926.82 (64)

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

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	17.88	15.88	12.92	9.78	7.31	6.17	6.67	8.67	11.63	14.77	17.24	18.38	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)

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

(73)m=	389.1	387.14	374.69	354.62	334.32	314.66	301.83	307.49	317.74	338	361.3	378.71	(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)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.5	x	0.7	=	27.34	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.5	x	0.7	=	53.49	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.5	x	0.7	=	88.09	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.5	x	0.7	=	128.48	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.5	x	0.7	=	157.45	(76)

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East	0.9x	0.77	x	5.74	x	115.77	x	0.5	x	0.7	=	161.18	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.5	x	0.7	=	153.45	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.5	x	0.7	=	131.81	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.5	x	0.7	=	102.45	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.5	x	0.7	=	63.47	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.5	x	0.7	=	34.09	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.5	x	0.7	=	22.49	(76)
South	0.9x	0.77	x	2.85	x	46.75	x	0.5	x	0.7	=	32.32	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.5	x	0.7	=	52.93	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.5	x	0.7	=	67.42	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.5	x	0.7	=	76.2	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.5	x	0.7	=	79.41	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.5	x	0.7	=	76.42	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.5	x	0.7	=	74.67	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.5	x	0.7	=	72.51	(78)
South	0.9x	0.77	x	2.85	x	101.89	x	0.5	x	0.7	=	70.43	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.5	x	0.7	=	57.09	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.5	x	0.7	=	38.31	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.5	x	0.7	=	27.93	(78)
West	0.9x	0.77	x	14.71	x	19.64	x	0.5	x	0.7	=	70.07	(80)
West	0.9x	0.77	x	14.71	x	38.42	x	0.5	x	0.7	=	137.08	(80)
West	0.9x	0.77	x	14.71	x	63.27	x	0.5	x	0.7	=	225.75	(80)
West	0.9x	0.77	x	14.71	x	92.28	x	0.5	x	0.7	=	329.25	(80)
West	0.9x	0.77	x	14.71	x	113.09	x	0.5	x	0.7	=	403.5	(80)
West	0.9x	0.77	x	14.71	x	115.77	x	0.5	x	0.7	=	413.06	(80)
West	0.9x	0.77	x	14.71	x	110.22	x	0.5	x	0.7	=	393.25	(80)
West	0.9x	0.77	x	14.71	x	94.68	x	0.5	x	0.7	=	337.79	(80)
West	0.9x	0.77	x	14.71	x	73.59	x	0.5	x	0.7	=	262.56	(80)
West	0.9x	0.77	x	14.71	x	45.59	x	0.5	x	0.7	=	162.66	(80)
West	0.9x	0.77	x	14.71	x	24.49	x	0.5	x	0.7	=	87.37	(80)
West	0.9x	0.77	x	14.71	x	16.15	x	0.5	x	0.7	=	57.63	(80)

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

(83)m=	129.74	243.5	381.27	533.92	640.36	650.66	621.36	542.12	435.44	283.22	159.78	108.04	(83)

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

(84)m=	518.83	630.64	755.95	888.55	974.68	965.32	923.2	849.6	753.18	621.22	521.08	486.75	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.95	0.92	0.86	0.76	0.63	0.49	0.37	0.41	0.61	0.83	0.93	0.96	(86)

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

(87)m=	18.73	19.08	19.6	20.19	20.62	20.87	20.95	20.94	20.74	20.14	19.32	18.67	(87)

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

(88)m=	19.93	19.94	19.94	19.95	19.95	19.97	19.97	19.97	19.96	19.95	19.95	19.94	(88)

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

(89)m=	0.94	0.91	0.85	0.73	0.59	0.42	0.29	0.33	0.55	0.8	0.91	0.95	(89)

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

(90)m=	16.92	17.42	18.16	18.98	19.54	19.85	19.94	19.93	19.72	18.93	17.79	16.84	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	17.83	18.26	18.88	19.59	20.09	20.36	20.45	20.44	20.23	19.54	18.56	17.76	(92)

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

(93)m=	17.83	18.26	18.88	19.59	20.09	20.36	20.45	20.44	20.23	19.54	18.56	17.76	(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=	0.92	0.89	0.82	0.72	0.59	0.45	0.33	0.37	0.57	0.78	0.89	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.13	558.99	622.6	640.74	576.62	430.6	301.51	311.2	427.22	485.65	465.29	453.86	(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=	1143.66	1125.71	1041.12	886.83	693.65	470.11	314.03	328.34	503.12	739.5	953.34	1133.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	494.41	380.84	311.38	177.19	87.07	0	0	0	0	188.86	351.4	505.94	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2497.08 (98)

Space heating requirement in kWh/m²/year 34.96 (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	766.96	603.78	618.39	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.86	0.9	0.88	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	660.56	545.24	546.25	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1202.06	1151.38	1066.38	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	389.88	450.97	386.97	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 1227.82 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.86 (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	84.15	97.34	83.52	0	0	0	0

Total = Sum(107) = 265.01 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 3.71 (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		2497.08	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2621.93	(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		1926.82	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	46.45	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	40.23	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		155.75	(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) =	155.75	(331)
Energy for lighting (calculated in Appendix L)		315.81	(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				93.5	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1073.09	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	24.11	(372)

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Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	1097.2	(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)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			1097.2	(376)
CO2 associated with space cooling	(315) x	0.52	=	20.88	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	80.83	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	163.91	(379)
Total CO2, kg/year	sum of (376)…(382) =			1362.82	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			19.08	(384)
EI rating (section 14)				84.31	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 34

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.75	(2a) =	196.4	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	196.4	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

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

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

0.47	0.47	0.46	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.42	0.44

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1	=	2.12			(26)
Windows Type 1			3.88	x1/[1/(1.4)+ 0.04]		=	5.14			(27)
Windows Type 2			9.93	x1/[1/(1.4)+ 0.04]		=	13.16			(27)
Windows Type 3			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Walls Type1	77.11	15.73	61.38	x	0.18	=	11.05			(29)
Walls Type2	10.2	2.12	8.08	x	0.18	=	1.45			(29)
Walls Type3	7.56	0	7.56	x	0.18	=	1.36			(29)
Roof	71.42	0	71.42	x	0.13	=	9.28			(30)
Total area of elements, m²			166.29							(31)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	46.12	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	1721.06	(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		21.1	(36)

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

Total fabric heat loss	(33) + (36) =	67.22	(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=	39.72	39.43	39.16	37.85	37.6	36.47	36.47	36.26	36.9	37.6	38.1	38.62	(38)

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

(39)m=	106.94	106.65	106.38	105.07	104.82	103.69	103.69	103.47	104.12	104.82	105.32	105.84	

Average = Sum(39)$_{1…12}$ /12= 105.07 (39)

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

(40)m=	1.5	1.49	1.49	1.47	1.47	1.45	1.45	1.45	1.46	1.47	1.47	1.48

Average = Sum(40)$_{1…12}$ /12= 1.47 (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)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

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

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

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

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.84 (55)

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98

(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98

(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

(59)

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

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

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

(62)m=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	

Output from water heater (annual)$_{1...12}$ 1969.92 (64)

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

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	17.89	15.89	12.92	9.78	7.31	6.17	6.67	8.67	11.64	14.78	17.25	18.39	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)

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

(73)m=	396.04	394.08	381.63	361.56	341.25	321.6	308.77	314.43	324.68	344.94	368.24	385.65	(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)	
East	0.9x	0.77	x	3.88	x	19.64	x	0.63	x	0.7	=	23.29	(76)
East	0.9x	0.77	x	3.88	x	38.42	x	0.63	x	0.7	=	45.56	(76)
East	0.9x	0.77	x	3.88	x	63.27	x	0.63	x	0.7	=	75.03	(76)
East	0.9x	0.77	x	3.88	x	92.28	x	0.63	x	0.7	=	109.42	(76)
East	0.9x	0.77	x	3.88	x	113.09	x	0.63	x	0.7	=	134.1	(76)

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East	0.9x	0.77	x	3.88	x	115.77	x	0.63	x	0.7	=	137.28	(76)
East	0.9x	0.77	x	3.88	x	110.22	x	0.63	x	0.7	=	130.69	(76)
East	0.9x	0.77	x	3.88	x	94.68	x	0.63	x	0.7	=	112.26	(76)
East	0.9x	0.77	x	3.88	x	73.59	x	0.63	x	0.7	=	87.26	(76)
East	0.9x	0.77	x	3.88	x	45.59	x	0.63	x	0.7	=	54.06	(76)
East	0.9x	0.77	x	3.88	x	24.49	x	0.63	x	0.7	=	29.04	(76)
East	0.9x	0.77	x	3.88	x	16.15	x	0.63	x	0.7	=	19.15	(76)
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	27.43	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	44.93	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	57.23	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	64.68	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	67.4	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	64.87	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	63.38	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	61.55	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	59.78	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	48.46	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	32.52	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	23.7	(78)
West	0.9x	0.77	x	9.93	x	19.64	x	0.63	x	0.7	=	59.6	(80)
West	0.9x	0.77	x	9.93	x	38.42	x	0.63	x	0.7	=	116.6	(80)
West	0.9x	0.77	x	9.93	x	63.27	x	0.63	x	0.7	=	192.02	(80)
West	0.9x	0.77	x	9.93	x	92.28	x	0.63	x	0.7	=	280.05	(80)
West	0.9x	0.77	x	9.93	x	113.09	x	0.63	x	0.7	=	343.21	(80)
West	0.9x	0.77	x	9.93	x	115.77	x	0.63	x	0.7	=	351.33	(80)
West	0.9x	0.77	x	9.93	x	110.22	x	0.63	x	0.7	=	334.48	(80)
West	0.9x	0.77	x	9.93	x	94.68	x	0.63	x	0.7	=	287.32	(80)
West	0.9x	0.77	x	9.93	x	73.59	x	0.63	x	0.7	=	223.32	(80)
West	0.9x	0.77	x	9.93	x	45.59	x	0.63	x	0.7	=	138.35	(80)
West	0.9x	0.77	x	9.93	x	24.49	x	0.63	x	0.7	=	74.32	(80)
West	0.9x	0.77	x	9.93	x	16.15	x	0.63	x	0.7	=	49.01	(80)

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

(83)m=	110.33	207.08	324.28	454.15	544.71	553.48	528.56	461.13	370.37	240.87	135.87	91.87	(83)

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

(84)m=	506.36	601.16	705.9	815.71	885.97	875.08	837.33	775.56	695.04	585.81	504.12	477.52	(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	0.94	0.84	0.68	0.52	0.58	0.82	0.96	0.99	1	(86)

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

(87)m=	19.41	19.61	19.94	20.37	20.72	20.92	20.98	20.97	20.81	20.35	19.8	19.39	(87)

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

(88)m=	19.69	19.69	19.7	19.71	19.71	19.72	19.72	19.73	19.72	19.71	19.71	19.7	(88)

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

(89)m=	0.99	0.99	0.97	0.91	0.78	0.58	0.38	0.44	0.73	0.94	0.99	1	(89)

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

(90)m=	17.62	17.91	18.39	19	19.45	19.67	19.72	19.71	19.58	18.98	18.2	17.58	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	18.53	18.77	19.17	19.69	20.09	20.3	20.35	20.35	20.2	19.67	19.01	18.49	(92)

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

(93)m=	18.53	18.77	19.17	19.69	20.09	20.3	20.35	20.35	20.2	19.67	19.01	18.49	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.91	0.8	0.63	0.45	0.51	0.77	0.94	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	502.6	592.17	681.45	744.13	711.33	548.45	380.62	394.79	534.51	553.03	497.12	474.7	(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=	1521.28	1479.13	1348.28	1133.66	879.19	591.1	389.19	408.39	635.46	950.72	1254.15	1512.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	757.9	596.04	496.12	280.46	124.89	0	0	0	0	295.88	545.06	772.3	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3868.65 (98)

Space heating requirement in kWh/m²/year 54.17 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	757.9	596.04	496.12	280.46	124.89	0	0	0	0	295.88	545.06	772.3	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	810.59	637.47	530.61	299.96	133.57	0	0	0	0	316.45	582.95	825.99	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4137.59 (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)

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Water heating

Output from water heater (calculated above)

193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82

Efficiency of water heater 79.8 (216)

(217)m=	88.1	87.88	87.39	86.28	84.19	79.8	79.8	79.8	79.8	86.32	87.63	88.18	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.49	194.05	205.2	186.67	187.73	177.38	170.74	186.83	186.33	193.45	201.06	214.14

Total = $Sum(219a)_{1...12}$ = 2323.07 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4137.59	
Water heating fuel used		2323.07	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		315.91	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	893.72	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	501.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1395.5	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.96	(268)
Total CO2, kg/year		sum of (265)…(271) =		1598.38	(272)

TER = 22.38 (273)

APPENDIX 6: BE GREEN MODELLING OUTPUT SHEETS

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Townhouse 1

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	39.87	(1a)	x	2.7	(2a)	=	107.65	(3a)
First floor	34.85	(1b)	x	3	(2b)	=	104.55	(3b)
Second floor	26.2	(1c)	x	2.9	(2c)	=	75.98	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	100.92	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	288.18	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

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

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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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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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.3	0.3	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.3	0.3	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(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			2.43	x	1	=	2.43			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			4.88	x1/[1/(1.3)+ 0.04]		=	6.03			(27)
Windows Type 2			2.92	x1/[1/(1.3)+ 0.04]		=	3.61			(27)
Windows Type 3			13.47	x1/[1/(1.3)+ 0.04]		=	16.65			(27)
Floor			39.87	x	0.11	=	4.3857			(28)
Walls	172.41	26.44	145.97	x	0.15	=	21.9			(29)
Roof	39.87	0	39.87	x	0.11	=	4.39			(30)
Total area of elements, m²			252.15							(31)
Party wall			37.81	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) = 62.12 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7544.31 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 25.65 (36)

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

Total fabric heat loss (33) + (36) = 87.77 (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=	28.4	28.07	27.74	26.09	25.76	24.11	24.11	23.78	24.77	25.76	26.42	27.08	(38)

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

(39)m=	116.18	115.85	115.52	113.87	113.54	111.89	111.89	111.56	112.55	113.54	114.2	114.86	

Average = $Sum(39)_{1...12}$ /12= 113.78 (39)

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

(40)m=	1.15	1.15	1.14	1.13	1.13	1.11	1.11	1.11	1.12	1.13	1.13	1.14

Average = $Sum(40)_{1...12}$ /12= 1.13 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.75 (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 99.46 (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=	109.41	105.43	101.45	97.47	93.49	89.52	89.52	93.49	97.47	101.45	105.43	109.41

Total = $Sum(44)_{1...12}$ = 1193.55 (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=	162.25	141.9	146.43	127.66	122.5	105.7	97.95	112.4	113.74	132.56	144.7	157.13

Total = $Sum(45)_{1...12}$ = 1564.93 (45)

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

(46)m=	24.34	21.29	21.96	19.15	18.37	15.86	14.69	16.86	17.06	19.88	21.7	23.57	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.72 (55)

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

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

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

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

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

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

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

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

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

(62)m=	207.83	183.08	192.02	171.78	168.08	149.82	143.53	157.98	157.85	178.14	188.81	202.71	(62)

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

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

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

Output from water heater

(64)m=	207.83	183.08	192.02	171.78	168.08	149.82	143.53	157.98	157.85	178.14	188.81	202.71

Output from water heater (annual)1…12 2101.62 (64)

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

(65)m=	90.41	80.12	85.15	77.74	77.2	70.44	69.03	73.84	73.11	80.54	83.4	88.71	(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=	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	(66)

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

(67)m=	23.04	20.46	16.64	12.6	9.42	7.95	8.59	11.17	14.99	19.03	22.21	23.68	(67)

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

(68)m=	257.81	260.48	253.74	239.39	221.27	204.24	192.87	190.19	196.94	211.29	229.4	246.43	(68)

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

(69)m=	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	(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=	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	(71)

Water heating gains (Table 5)

(72)m=	121.52	119.23	114.46	107.97	103.76	97.83	92.79	99.25	101.54	108.25	115.83	119.24	(72)

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

(73)m=	466.59	464.39	449.06	424.18	398.67	374.24	358.47	364.83	377.68	402.79	431.67	453.57	(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	0.77	x	4.88	x	10.63	x	0.5	x	0.7	=	12.59	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.5	x	0.7	=	24.05	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.5	x	0.7	=	40.87	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.5	x	0.7	=	65.65	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.5	x	0.7	=	88.44	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.5	x	0.7	=	94.67	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.5	x	0.7	=	88.39	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.5	x	0.7	=	70.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.5	x	0.7	=	49.14	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.5	x	0.7	=	28.63	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.5	x	0.7	=	15.53	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.5	x	0.7	=	10.49	(74)
East	0.9x	0.77	x	2.92	x	19.64	x	0.5	x	0.7	=	13.91	(76)
East	0.9x	0.77	x	2.92	x	38.42	x	0.5	x	0.7	=	27.21	(76)
East	0.9x	0.77	x	2.92	x	63.27	x	0.5	x	0.7	=	44.81	(76)
East	0.9x	0.77	x	2.92	x	92.28	x	0.5	x	0.7	=	65.36	(76)
East	0.9x	0.77	x	2.92	x	113.09	x	0.5	x	0.7	=	80.1	(76)
East	0.9x	0.77	x	2.92	x	115.77	x	0.5	x	0.7	=	81.99	(76)
East	0.9x	0.77	x	2.92	x	110.22	x	0.5	x	0.7	=	78.06	(76)
East	0.9x	0.77	x	2.92	x	94.68	x	0.5	x	0.7	=	67.05	(76)
East	0.9x	0.77	x	2.92	x	73.59	x	0.5	x	0.7	=	52.12	(76)
East	0.9x	0.77	x	2.92	x	45.59	x	0.5	x	0.7	=	32.29	(76)
East	0.9x	0.77	x	2.92	x	24.49	x	0.5	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	2.92	x	16.15	x	0.5	x	0.7	=	11.44	(76)
West	0.9x	0.77	x	13.47	x	19.64	x	0.5	x	0.7	=	64.17	(80)
West	0.9x	0.77	x	13.47	x	38.42	x	0.5	x	0.7	=	125.53	(80)
West	0.9x	0.77	x	13.47	x	63.27	x	0.5	x	0.7	=	206.72	(80)
West	0.9x	0.77	x	13.47	x	92.28	x	0.5	x	0.7	=	301.49	(80)
West	0.9x	0.77	x	13.47	x	113.09	x	0.5	x	0.7	=	369.49	(80)
West	0.9x	0.77	x	13.47	x	115.77	x	0.5	x	0.7	=	378.24	(80)
West	0.9x	0.77	x	13.47	x	110.22	x	0.5	x	0.7	=	360.1	(80)
West	0.9x	0.77	x	13.47	x	94.68	x	0.5	x	0.7	=	309.32	(80)
West	0.9x	0.77	x	13.47	x	73.59	x	0.5	x	0.7	=	240.43	(80)
West	0.9x	0.77	x	13.47	x	45.59	x	0.5	x	0.7	=	148.95	(80)
West	0.9x	0.77	x	13.47	x	24.49	x	0.5	x	0.7	=	80.01	(80)
West	0.9x	0.77	x	13.47	x	16.15	x	0.5	x	0.7	=	52.77	(80)

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

(83)m=	90.66	176.79	292.41	432.5	538.02	554.91	526.55	446.5	341.69	209.87	112.88	74.7	(83)

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

(84)m=	557.25	641.18	741.46	856.68	936.69	929.15	885.02	811.33	719.37	612.66	544.55	528.27	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.96	0.93	0.87	0.77	0.63	0.5	0.55	0.75	0.91	0.96	0.98	(86)

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

(87)m=	18.53	18.78	19.25	19.87	20.4	20.76	20.91	20.88	20.58	19.88	19.1	18.49	(87)

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

(88)m=	19.96	19.96	19.96	19.98	19.98	19.99	19.99	20	19.99	19.98	19.98	19.97	(88)

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

(89)m=	0.97	0.95	0.92	0.85	0.73	0.56	0.4	0.45	0.7	0.89	0.95	0.97	(89)

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

(90)m=	16.64	17.02	17.69	18.58	19.3	19.77	19.93	19.91	19.56	18.62	17.49	16.59	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	17.12	17.47	18.09	18.91	19.58	20.02	20.18	20.16	19.82	18.94	17.9	17.07	(92)

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

(93)m=	17.12	17.47	18.09	18.91	19.58	20.02	20.18	20.16	19.82	18.94	17.9	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=	0.95	0.93	0.89	0.82	0.71	0.56	0.42	0.47	0.69	0.86	0.93	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	529.63	596.82	661.64	701.79	664.1	521.55	372.67	381.06	493.17	526.74	507.44	504.99	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1489.66	1456.13	1339.08	1139.57	894.93	606.96	400.6	418.99	644.13	946.78	1233.7	1478.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	714.26	577.46	504.01	315.2	171.74	0	0	0	0	312.5	522.91	724.43	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3842.52 | (98)

Space heating requirement in kWh/m²/year | 38.07 | (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	1051.75	827.97	847.84	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.77	0.83	0.8	0	0	0	0	(101)

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Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	807.78	685.59	676.61	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	1180.34	1126.78	1042.12	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	268.24	328.24	271.94	0	0	0	0

Total = Sum(104) = 868.42 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.6 (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) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	40.03	48.98	40.58	0	0	0	0

Total = Sum(107) = 129.59 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.28 (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 heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		3842.52	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	4034.64	(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		2101.62	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2206.7	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	62.41	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	19.67	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		263.68	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)

Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =			263.68	(331)
Energy for lighting (calculated in Appendix L)				406.91	(332)
Electricity generated by PVs (Appendix M) (negative quantity)				-482.91	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)				0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				289	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	1120.85	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	32.39	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1153.24	(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) =				1153.24	(376)
CO2 associated with space cooling	(315) x		0.52	=	10.21	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	136.85	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	211.19	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.52	x 0.01 =	-250.63	(380)
Total CO2, kg/year	sum of (376)…(382) =				1260.86	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.49	(384)
EI rating (section 14)					88.42	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Townhouse 1

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	39.87	(1a)	x	2.7	(2a)	=	107.65	(3a)
First floor	34.85	(1b)	x	3	(2b)	=	104.55	(3b)
Second floor	26.2	(1c)	x	2.9	(2c)	=	75.98	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	100.92	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	288.18	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.14	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(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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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

0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(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			2.43	x	1	=	2.43			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			4.6	x1/[1/(1.4)+ 0.04]		=	6.1			(27)
Windows Type 2			2.75	x1/[1/(1.4)+ 0.04]		=	3.65			(27)
Windows Type 3			12.7	x1/[1/(1.4)+ 0.04]		=	16.84			(27)
Floor			39.87	x	0.13	=	5.1831			(28)
Walls	172.41	25.22	147.19	x	0.18	=	26.49			(29)
Roof	39.87	0	39.87	x	0.13	=	5.18			(30)
Total area of elements, m²			252.15							(31)
Party wall			37.81	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) = 68.61 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7561.39 (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 26.76 (36)

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

Total fabric heat loss (33) + (36) = 95.37 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.55	57.16	56.78	54.99	54.66	53.1	53.1	52.81	53.7	54.66	55.33	56.04	(38)

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

(39)m=	152.92	152.53	152.15	150.36	150.02	148.47	148.47	148.18	149.07	150.02	150.7	151.41	

Average = Sum(39)$_{1...12}$ /12= 150.36 (39)

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

(40)m=	1.52	1.51	1.51	1.49	1.49	1.47	1.47	1.47	1.48	1.49	1.49	1.5	

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 2.75 (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 99.46 (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=	109.41	105.43	101.45	97.47	93.49	89.52	89.52	93.49	97.47	101.45	105.43	109.41	

Total = Sum(44)$_{1...12}$ = 1193.55 (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=	162.25	141.9	146.43	127.66	122.5	105.7	97.95	112.4	113.74	132.56	144.7	157.13	

Total = Sum(45)$_{1...12}$ = 1564.93 (45)

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

(46)m=	24.34	21.29	21.96	19.15	18.37	15.86	14.69	16.86	17.06	19.88	21.7	23.57	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.84 (55)

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	211.49	186.38	195.68	175.32	171.74	153.36	147.19	161.64	161.4	181.8	192.35	206.37	(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=	211.49	186.38	195.68	175.32	171.74	153.36	147.19	161.64	161.4	181.8	192.35	206.37

Output from water heater (annual)$_{1…12}$ — 2144.72 (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=	93.34	82.77	88.08	80.57	80.12	73.27	71.96	76.77	75.94	83.47	86.23	91.64	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	(66)

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

(67)m=	23.16	20.57	16.73	12.67	9.47	7.99	8.64	11.23	15.07	19.13	22.33	23.81	(67)

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

(68)m=	257.81	260.48	253.74	239.39	221.27	204.24	192.87	190.19	196.94	211.29	229.4	246.43	(68)

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

(69)m=	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	-109.92	(71)

Water heating gains (Table 5)

(72)m=	125.46	123.16	118.39	111.9	107.69	101.76	96.72	103.18	105.48	112.19	119.77	123.17	(72)

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

(73)m=	473.65	471.43	456.08	431.18	405.65	381.22	365.45	371.82	384.7	409.83	438.72	460.63	(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	0.77	x 4.6	x	10.63	x	0.63	x	0.7	=	14.95	(74)
North	0.9x	0.77	x 4.6	x	20.32	x	0.63	x	0.7	=	28.57	(74)
North	0.9x	0.77	x 4.6	x	34.53	x	0.63	x	0.7	=	48.54	(74)
North	0.9x	0.77	x 4.6	x	55.46	x	0.63	x	0.7	=	77.97	(74)
North	0.9x	0.77	x 4.6	x	74.72	x	0.63	x	0.7	=	105.04	(74)
North	0.9x	0.77	x 4.6	x	79.99	x	0.63	x	0.7	=	112.44	(74)
North	0.9x	0.77	x 4.6	x	74.68	x	0.63	x	0.7	=	104.98	(74)
North	0.9x	0.77	x 4.6	x	59.25	x	0.63	x	0.7	=	83.29	(74)
North	0.9x	0.77	x 4.6	x	41.52	x	0.63	x	0.7	=	58.36	(74)
North	0.9x	0.77	x 4.6	x	24.19	x	0.63	x	0.7	=	34.01	(74)
North	0.9x	0.77	x 4.6	x	13.12	x	0.63	x	0.7	=	18.44	(74)
North	0.9x	0.77	x 4.6	x	8.86	x	0.63	x	0.7	=	12.46	(74)
East	0.9x	0.77	x 2.75	x	19.64	x	0.63	x	0.7	=	16.51	(76)
East	0.9x	0.77	x 2.75	x	38.42	x	0.63	x	0.7	=	32.29	(76)
East	0.9x	0.77	x 2.75	x	63.27	x	0.63	x	0.7	=	53.18	(76)
East	0.9x	0.77	x 2.75	x	92.28	x	0.63	x	0.7	=	77.56	(76)
East	0.9x	0.77	x 2.75	x	113.09	x	0.63	x	0.7	=	95.05	(76)
East	0.9x	0.77	x 2.75	x	115.77	x	0.63	x	0.7	=	97.3	(76)
East	0.9x	0.77	x 2.75	x	110.22	x	0.63	x	0.7	=	92.63	(76)
East	0.9x	0.77	x 2.75	x	94.68	x	0.63	x	0.7	=	79.57	(76)
East	0.9x	0.77	x 2.75	x	73.59	x	0.63	x	0.7	=	61.85	(76)
East	0.9x	0.77	x 2.75	x	45.59	x	0.63	x	0.7	=	38.31	(76)
East	0.9x	0.77	x 2.75	x	24.49	x	0.63	x	0.7	=	20.58	(76)
East	0.9x	0.77	x 2.75	x	16.15	x	0.63	x	0.7	=	13.57	(76)
West	0.9x	0.77	x 12.7	x	19.64	x	0.63	x	0.7	=	76.23	(80)
West	0.9x	0.77	x 12.7	x	38.42	x	0.63	x	0.7	=	149.12	(80)
West	0.9x	0.77	x 12.7	x	63.27	x	0.63	x	0.7	=	245.58	(80)
West	0.9x	0.77	x 12.7	x	92.28	x	0.63	x	0.7	=	358.17	(80)
West	0.9x	0.77	x 12.7	x	113.09	x	0.63	x	0.7	=	438.95	(80)
West	0.9x	0.77	x 12.7	x	115.77	x	0.63	x	0.7	=	449.34	(80)
West	0.9x	0.77	x 12.7	x	110.22	x	0.63	x	0.7	=	427.79	(80)
West	0.9x	0.77	x 12.7	x	94.68	x	0.63	x	0.7	=	367.46	(80)
West	0.9x	0.77	x 12.7	x	73.59	x	0.63	x	0.7	=	285.62	(80)
West	0.9x	0.77	x 12.7	x	45.59	x	0.63	x	0.7	=	176.94	(80)
West	0.9x	0.77	x 12.7	x	24.49	x	0.63	x	0.7	=	95.05	(80)
West	0.9x	0.77	x 12.7	x	16.15	x	0.63	x	0.7	=	62.69	(80)

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

(83)m=	107.68	209.98	347.3	513.69	639.03	659.08	625.4	530.32	405.83	249.27	134.07	88.72	(83)

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

(84)m=	581.33	681.41	803.38	944.87	1044.68	1040.3	990.85	902.14	790.53	659.09	572.8	549.35	(84)

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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	0.97	0.9	0.77	0.61	0.68	0.89	0.98	1	1	(86)

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

(87)m=	19.28	19.45	19.77	20.21	20.6	20.87	20.96	20.94	20.72	20.2	19.67	19.25	(87)

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

(88)m=	19.68	19.68	19.68	19.7	19.7	19.71	19.71	19.71	19.7	19.7	19.69	19.69	(88)

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

(89)m=	1	0.99	0.99	0.95	0.86	0.66	0.46	0.52	0.83	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=	17.41	17.66	18.13	18.77	19.3	19.62	19.7	19.69	19.47	18.77	17.99	17.39	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	17.89	18.12	18.55	19.13	19.64	19.94	20.02	20.01	19.79	19.13	18.42	17.86	(92)

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

(93)m=	17.89	18.12	18.55	19.13	19.64	19.94	20.02	20.01	19.79	19.13	18.42	17.86	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.85	0.68	0.5	0.56	0.83	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	578.94	675.89	787.43	891.21	891.34	711.46	491.55	507.91	658.05	637.55	568.44	547.56	(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=	2077.84	2016.16	1832.81	1538.65	1190.56	792.55	507.5	534.46	848.03	1280.28	1705.44	2068.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1115.18	900.66	777.77	466.15	222.62	0	0	0	0	478.19	818.64	1131.63	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 5910.84 | (98)

Space heating requirement in kWh/m²/year | 58.57 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

TER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1115.18	900.66	777.77	466.15	222.62	0	0	0	0	478.19	818.64	1131.63		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1192.71	963.27	831.84	498.56	238.1	0	0	0	0	511.44	875.55	1210.29		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													6321.75	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)
Water heating														
Output from water heater (calculated above)														
	211.49	186.38	195.68	175.32	171.74	153.36	147.19	161.64	161.4	181.8	192.35	206.37		
Efficiency of water heater													79.8	(216)
(217)m=	88.61	88.47	88.12	87.3	85.51	79.8	79.8	79.8	79.8	87.28	88.25	88.67		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	238.69	210.68	222.04	200.82	200.85	192.18	184.45	202.56	202.25	208.3	217.96	232.75		
Total = Sum(219a)$_{1...12}$ =													2513.54	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		6321.75	
Water heating fuel used		2513.54	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		409.05	(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	=	1365.5	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	542.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1908.42	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	212.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		2159.64	(272)

TER = 31.8 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 05

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			2.68	x	1	=	2.68			(26)
Windows Type 1			5.74	x1/[1/(1.3)+ 0.04]		=	7.09			(27)
Windows Type 2			6.05	x1/[1/(1.3)+ 0.04]		=	7.48			(27)
Floor			71.42	x	0.11	=	7.8562			(28)
Walls Type1	60.25	14.47	45.78	x	0.15	=	6.87			(29)
Walls Type2	18.42	0	18.42	x	0.13	=	2.43			(29)
Total area of elements, m²			150.09							(31)
Party wall			19.66	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) = 34.41 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 9148.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 11.24 (36)

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

Total fabric heat loss (33) + (36) = 45.65 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.81	18.6	18.38	17.31	17.1	16.03	16.03	15.81	16.46	17.1	17.53	17.96	(38)

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

(39)m=	64.46	64.24	64.03	62.96	62.75	61.67	61.67	61.46	62.1	62.75	63.17	63.6	

Average = Sum(39)$_{1…12}$ /12= 62.91 (39)

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

(40)m=	0.9	0.9	0.9	0.88	0.88	0.86	0.86	0.86	0.87	0.88	0.88	0.89

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

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = $Sum(44)_{1...12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = $Sum(45)_{1...12}$ = 1390.13 (45)

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

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.72 (55)

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

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

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

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

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

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

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

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

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

(62)m=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	

Output from water heater (annual)$_{1...12}$ 1926.82 (64)

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

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

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

(67)m=	18.54	16.47	13.39	10.14	7.58	6.4	6.92	8.99	12.06	15.32	17.88	19.06	(67)

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

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

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

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)

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

(73)m=	389.76	387.73	375.17	354.98	334.59	314.89	302.08	307.81	318.17	338.55	361.94	379.39	(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)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.5	x	0.7	=	27.34	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.5	x	0.7	=	53.49	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.5	x	0.7	=	88.09	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.5	x	0.7	=	128.48	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.5	x	0.7	=	157.45	(76)

East	0.9x	0.77	x	5.74	x	115.77	x	0.5	x	0.7	=	161.18	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.5	x	0.7	=	153.45	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.5	x	0.7	=	131.81	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.5	x	0.7	=	102.45	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.5	x	0.7	=	63.47	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.5	x	0.7	=	34.09	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.5	x	0.7	=	22.49	(76)
West	0.9x	0.77	x	6.05	x	19.64	x	0.5	x	0.7	=	28.82	(80)
West	0.9x	0.77	x	6.05	x	38.42	x	0.5	x	0.7	=	56.38	(80)
West	0.9x	0.77	x	6.05	x	63.27	x	0.5	x	0.7	=	92.85	(80)
West	0.9x	0.77	x	6.05	x	92.28	x	0.5	x	0.7	=	135.41	(80)
West	0.9x	0.77	x	6.05	x	113.09	x	0.5	x	0.7	=	165.96	(80)
West	0.9x	0.77	x	6.05	x	115.77	x	0.5	x	0.7	=	169.88	(80)
West	0.9x	0.77	x	6.05	x	110.22	x	0.5	x	0.7	=	161.74	(80)
West	0.9x	0.77	x	6.05	x	94.68	x	0.5	x	0.7	=	138.93	(80)
West	0.9x	0.77	x	6.05	x	73.59	x	0.5	x	0.7	=	107.99	(80)
West	0.9x	0.77	x	6.05	x	45.59	x	0.5	x	0.7	=	66.9	(80)
West	0.9x	0.77	x	6.05	x	24.49	x	0.5	x	0.7	=	35.94	(80)
West	0.9x	0.77	x	6.05	x	16.15	x	0.5	x	0.7	=	23.7	(80)

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

(83)m=	56.16	109.87	180.94	263.89	323.41	331.06	315.19	270.74	210.44	130.37	70.03	46.19	(83)

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

(84)m=	445.92	497.6	556.11	618.87	657.99	645.96	617.27	578.55	528.61	468.92	431.97	425.58	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.9	0.83	0.71	0.55	0.42	0.46	0.67	0.86	0.94	0.96	(86)

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

(87)m=	19.22	19.45	19.83	20.31	20.68	20.9	20.97	20.96	20.8	20.32	19.7	19.19	(87)

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

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

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

(89)m=	0.95	0.93	0.89	0.81	0.67	0.5	0.35	0.39	0.62	0.84	0.93	0.96	(89)

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

(90)m=	17.77	18.1	18.65	19.33	19.82	20.1	20.18	20.17	19.99	19.35	18.47	17.73	(90)

fLA = Living area ÷ (4) = | 0.38 | (91)

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

(92)m=	18.33	18.62	19.1	19.71	20.15	20.41	20.48	20.47	20.3	19.72	18.94	18.29	(92)

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

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(93)m=	18.33	18.62	19.1	19.71	20.15	20.41	20.48	20.47	20.3	19.72	18.94	18.29	(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=	0.94	0.92	0.87	0.79	0.67	0.51	0.38	0.41	0.63	0.83	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.21	455.76	485.31	489.31	440.66	330.71	231.64	239.72	331.87	387.31	394.64	401.88	(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=	904.26	881.18	806.93	680.29	530.11	358.04	239.22	250.14	385	572.24	748.04	896.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	361.62	285.88	239.29	137.5	66.55	0	0	0	0	137.59	254.45	367.68	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1850.56 (98)

Space heating requirement in kWh/m²/year 25.91 (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	579.74	456.39	467.1	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	506.5	418.57	421.04	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	829.08	794.13	749.99	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	232.26	279.41	244.74	0	0	0	0	

Total = Sum(104)6...8 = 756.4 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.74 (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	42.74	51.42	45.04	0	0	0	0

Total = Sum(107)6...8 = 139.19 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.95 (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)

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The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1850.56	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1943.09	(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		1926.82	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	39.66	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	21.13	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		161.41	(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) =	161.41	(331)
Energy for lighting (calculated in Appendix L)		327.49	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-482.91	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				289	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	712.28	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.58	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	732.86	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				732.86	(376)
CO2 associated with space cooling	(315) x		0.52	=	10.97	(377)

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CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	83.77	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	169.97	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-250.63	(380)
Total CO2, kg/year	sum of (376)…(382) =			746.94	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			10.46	(384)
EI rating (section 14)				91.4	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 05

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.68	x	1	=	2.68			(26)
Windows Type 1			5.74	x1/[1/(1.4)+ 0.04]		=	7.61			(27)
Windows Type 2			6.05	x1/[1/(1.4)+ 0.04]		=	8.02			(27)
Floor			71.42	x	0.13	=	9.284599			(28)
Walls Type1	60.25	14.47	45.78	x	0.18	=	8.24			(29)
Walls Type2	18.42	0	18.42	x	0.18	=	3.32			(29)
Total area of elements, m²			150.09							(31)
Party wall			19.66	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) = 39.15 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 9148.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.02 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.18 (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=	39.81	39.57	39.34	38.22	38.01	37.04	37.04	36.86	37.42	38.01	38.43	38.88	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	86.99	86.75	86.51	85.4	85.19	84.22	84.22	84.04	84.59	85.19	85.61	86.05	

Average = Sum(39)$_{1\ldots12}$ /12= 85.4 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.22	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.18	1.19	1.2	1.2

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.28 (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 — 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.55 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.84 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0.84 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82

Output from water heater (annual)$_{1...12}$ 1969.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.54	16.47	13.39	10.14	7.58	6.4	6.92	8.99	12.06	15.32	17.88	19.06	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	396.69	394.66	382.1	361.92	341.52	321.83	309.01	314.74	325.1	345.49	368.88	386.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.63	x	0.7	=	34.45	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.63	x	0.7	=	67.4	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.63	x	0.7	=	110.99	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.63	x	0.7	=	161.88	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.63	x	0.7	=	198.39	(76)

East	0.9x	0.77	x	5.74	x	115.77	x	0.63	x	0.7	=	203.09	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.63	x	0.7	=	193.35	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.63	x	0.7	=	166.08	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.63	x	0.7	=	129.09	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.63	x	0.7	=	79.97	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.63	x	0.7	=	42.96	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.63	x	0.7	=	28.33	(76)
West	0.9x	0.77	x	6.05	x	19.64	x	0.63	x	0.7	=	36.31	(80)
West	0.9x	0.77	x	6.05	x	38.42	x	0.63	x	0.7	=	71.04	(80)
West	0.9x	0.77	x	6.05	x	63.27	x	0.63	x	0.7	=	116.99	(80)
West	0.9x	0.77	x	6.05	x	92.28	x	0.63	x	0.7	=	170.62	(80)
West	0.9x	0.77	x	6.05	x	113.09	x	0.63	x	0.7	=	209.1	(80)
West	0.9x	0.77	x	6.05	x	115.77	x	0.63	x	0.7	=	214.05	(80)
West	0.9x	0.77	x	6.05	x	110.22	x	0.63	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	6.05	x	94.68	x	0.63	x	0.7	=	175.05	(80)
West	0.9x	0.77	x	6.05	x	73.59	x	0.63	x	0.7	=	136.06	(80)
West	0.9x	0.77	x	6.05	x	45.59	x	0.63	x	0.7	=	84.29	(80)
West	0.9x	0.77	x	6.05	x	24.49	x	0.63	x	0.7	=	45.28	(80)
West	0.9x	0.77	x	6.05	x	16.15	x	0.63	x	0.7	=	29.86	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	70.77	138.44	227.98	332.5	407.49	417.14	397.14	341.13	265.16	164.27	88.24	58.2	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	467.46	533.1	610.09	694.42	749.02	738.97	706.15	655.88	590.26	509.75	457.12	444.52	(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	0.95	0.85	0.68	0.51	0.57	0.83	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.72	19.87	20.15	20.51	20.8	20.95	20.99	20.98	20.87	20.49	20.04	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.94	19.94	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.8	0.59	0.4	0.45	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.21	18.44	18.84	19.36	19.73	19.91	19.93	19.93	19.83	19.34	18.69	18.18	(90)

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.79	18.99	19.34	19.8	20.14	20.31	20.34	20.34	20.23	19.78	19.21	18.76	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.79	18.99	19.34	19.8	20.14	20.31	20.34	20.34	20.23	19.78	19.21	18.76	(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	0.93	0.81	0.62	0.44	0.5	0.77	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	464.94	527.5	594.32	642.87	608.7	458.75	311.56	325.06	456.32	485.85	452.31	442.62	(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=	1260.29	1222.07	1110.86	930.77	719.18	480.66	314.86	330.75	518.81	782.02	1036.64	1253.11	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	591.74	466.75	384.31	207.28	82.19	0	0	0	0	220.35	420.72	603.01	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2976.35 (98)

Space heating requirement in kWh/m²/year 41.67 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	591.74	466.75	384.31	207.28	82.19	0	0	0	0	220.35	420.72	603.01	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	632.88	499.2	411.02	221.69	87.91	0	0	0	0	235.67	449.97	644.93	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3183.26 (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)													
	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	
Efficiency of water heater												79.8	(216)
(217)m=	87.61	87.37	86.8	85.49	83.16	79.8	79.8	79.8	79.8	85.55	87.05	87.7	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	220.72	195.19	206.6	188.4	190.05	177.38	170.74	186.83	186.33	195.19	202.39	215.31	

Total = Sum(219a)$_{1...12}$ = 2335.14 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3183.26

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Water heating fuel used			2335.14	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.49	(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	=	687.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	504.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1191.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	169.97	(268)
Total CO2, kg/year		sum of (265)…(271) =		1400.87	(272)

TER = 28.79 (273)

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User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 13

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	71.42	(1a)	x	2.85	(2a)	=	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			203.55	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			2.12	x	1	=	2.12			(26)
Windows Type 1			5.74	x1/[1/(1.3)+ 0.04]		=	7.09			(27)
Windows Type 2			13.09	x1/[1/(1.3)+ 0.04]		=	16.18			(27)
Floor			71.42	x	0.11	=	7.8562			(28)
Walls Type1	60.25	18.83	41.42	x	0.15	=	6.21			(29)
Walls Type2	10.57	2.12	8.45	x	0.14	=	1.19			(29)
Walls Type3	7.84	0	7.84	x	0.13	=	1.04			(29)
Total area of elements, m²			150.08							(31)
Party wall			19.66	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) = 41.69 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6557.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 12.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.59 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.81	18.6	18.38	17.31	17.1	16.03	16.03	15.81	16.46	17.1	17.53	17.96	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.41	73.19	72.98	71.91	71.69	70.62	70.62	70.41	71.05	71.69	72.12	72.55	

Average = $Sum(39)_{1…12}$ /12= 71.85 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.03	1.02	1.02	1.01	1	0.99	0.99	0.99	0.99	1	1.01	1.02

Average = Sum(40)$_{1…12}$ /12= 1.01 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16

Output from water heater (annual)1…12 | 1926.82 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.88	15.88	12.92	9.78	7.31	6.17	6.67	8.67	11.63	14.77	17.24	18.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	389.1	387.14	374.69	354.62	334.32	314.66	301.83	307.49	317.74	338	361.3	378.71	(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)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.5	x	0.7	=	27.34	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.5	x	0.7	=	53.49	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.5	x	0.7	=	88.09	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.5	x	0.7	=	128.48	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.5	x	0.7	=	157.45	(76)

East	0.9x	0.77	x	5.74	x	115.77	x	0.5	x	0.7	=	161.18	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.5	x	0.7	=	153.45	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.5	x	0.7	=	131.81	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.5	x	0.7	=	102.45	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.5	x	0.7	=	63.47	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.5	x	0.7	=	34.09	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.5	x	0.7	=	22.49	(76)
West	0.9x	0.77	x	13.09	x	19.64	x	0.5	x	0.7	=	62.36	(80)
West	0.9x	0.77	x	13.09	x	38.42	x	0.5	x	0.7	=	121.98	(80)
West	0.9x	0.77	x	13.09	x	63.27	x	0.5	x	0.7	=	200.89	(80)
West	0.9x	0.77	x	13.09	x	92.28	x	0.5	x	0.7	=	292.99	(80)
West	0.9x	0.77	x	13.09	x	113.09	x	0.5	x	0.7	=	359.07	(80)
West	0.9x	0.77	x	13.09	x	115.77	x	0.5	x	0.7	=	367.57	(80)
West	0.9x	0.77	x	13.09	x	110.22	x	0.5	x	0.7	=	349.94	(80)
West	0.9x	0.77	x	13.09	x	94.68	x	0.5	x	0.7	=	300.59	(80)
West	0.9x	0.77	x	13.09	x	73.59	x	0.5	x	0.7	=	233.64	(80)
West	0.9x	0.77	x	13.09	x	45.59	x	0.5	x	0.7	=	144.74	(80)
West	0.9x	0.77	x	13.09	x	24.49	x	0.5	x	0.7	=	77.75	(80)
West	0.9x	0.77	x	13.09	x	16.15	x	0.5	x	0.7	=	51.28	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	89.7	175.47	288.98	421.46	516.52	528.75	503.39	432.41	336.1	208.22	111.85	73.77	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	478.8	562.61	663.67	776.09	850.84	843.41	805.22	739.89	653.83	546.22	473.15	452.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.95	0.93	0.88	0.78	0.64	0.49	0.37	0.41	0.63	0.84	0.93	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.99	19.29	19.76	20.3	20.69	20.9	20.97	20.95	20.79	20.25	19.53	18.94	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.06	20.06	20.07	20.08	20.08	20.09	20.09	20.1	20.09	20.08	20.08	20.07	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.92	0.86	0.75	0.6	0.43	0.3	0.34	0.57	0.81	0.92	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.37	17.8	18.47	19.23	19.74	20	20.07	20.06	19.88	19.17	18.15	17.31	(90)

fLA = Living area ÷ (4) = | 0.5 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.19	18.55	19.12	19.77	20.22	20.45	20.52	20.51	20.34	19.72	18.85	18.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.19	18.55	19.12	19.77	20.22	20.45	20.52	20.51	20.34	19.72	18.85	18.13	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.93	0.9	0.84	0.74	0.61	0.46	0.33	0.37	0.59	0.8	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	446.42	507.36	560.18	576.03	517.51	384.39	268.39	277.35	382.83	438.15	428.24	425.38	(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=	1019.57	998.96	920.8	781.76	610.58	413.4	277.01	289.51	443.22	653.52	847.09	1010.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	426.43	330.36	268.3	148.12	69.25	0	0	0	0	160.24	301.57	435.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2139.81 (98)

Space heating requirement in kWh/m²/year 29.96 (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	663.86	522.61	535.11	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.88	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	586.49	481.71	483.6	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1059.57	1013.49	938.14	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	340.62	395.64	338.18	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 1074.45 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.86 (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	73.52	85.39	72.99	0	0	0	0

Total = Sum(107)$_{6...8}$ = 231.9 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 3.25 (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)

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The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2139.81	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2246.8	(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		1926.82	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.7	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	35.2	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		161.41	(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) =	161.41	(331)
Energy for lighting (calculated in Appendix L)		315.81	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-482.91	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				289	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	766.82	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	22.16	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	788.98	(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) =				788.98	(376)
CO2 associated with space cooling	(315) x		0.52	=	18.27	(377)

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CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	83.77	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	163.91	(379)
Energy saving/generation technologies (333) to (334) as applicable					
Item 1		0.52	x 0.01 =	-250.63	(380)
Total CO2, kg/year	sum of (376)…(382) =			804.3	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			11.26	(384)
EI rating (section 14)				90.74	(385)

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User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 13

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	71.42	(1a)	x	2.85	(2a)	=	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			203.55	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1	=	2.12			(26)
Windows Type 1			4.8	x1/[1/(1.4)+ 0.04]		=	6.36			(27)
Windows Type 2			10.94	x1/[1/(1.4)+ 0.04]		=	14.5			(27)
Floor			71.42	x	0.13	=	9.284599			(28)
Walls Type1	60.25	15.74	44.51	x	0.18	=	8.01			(29)
Walls Type2	10.57	2.12	8.45	x	0.18	=	1.52			(29)
Walls Type3	7.84	0	7.84	x	0.18	=	1.41			(29)
Total area of elements, m²			150.08							(31)
Party wall			19.66	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) = 43.22 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6600.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 11.77 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.98 (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=	39.81	39.57	39.34	38.22	38.01	37.04	37.04	36.86	37.42	38.01	38.43	38.88	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.8	94.55	94.32	93.2	93	92.03	92.03	91.85	92.4	93	93.42	93.86	

Average = Sum(39)$_{1…12}$ /12= 93.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = Sum(40)$_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.84 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98

(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	

Output from water heater (annual)$_{1...12}$ 1969.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.89	15.89	12.92	9.78	7.31	6.17	6.67	8.67	11.64	14.78	17.25	18.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	396.04	394.08	381.63	361.56	341.25	321.6	308.77	314.42	324.68	344.94	368.24	385.65	(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)	
East	0.9x	0.77	x	4.8	x	19.64	x	0.63	x	0.7	=	28.81	(76)
East	0.9x	0.77	x	4.8	x	38.42	x	0.63	x	0.7	=	56.36	(76)
East	0.9x	0.77	x	4.8	x	63.27	x	0.63	x	0.7	=	92.82	(76)
East	0.9x	0.77	x	4.8	x	92.28	x	0.63	x	0.7	=	135.37	(76)
East	0.9x	0.77	x	4.8	x	113.09	x	0.63	x	0.7	=	165.9	(76)

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East	0.9x	0.77	x	4.8	x	115.77	x	0.63	x	0.7	=	169.83	(76)
East	0.9x	0.77	x	4.8	x	110.22	x	0.63	x	0.7	=	161.68	(76)
East	0.9x	0.77	x	4.8	x	94.68	x	0.63	x	0.7	=	138.88	(76)
East	0.9x	0.77	x	4.8	x	73.59	x	0.63	x	0.7	=	107.95	(76)
East	0.9x	0.77	x	4.8	x	45.59	x	0.63	x	0.7	=	66.88	(76)
East	0.9x	0.77	x	4.8	x	24.49	x	0.63	x	0.7	=	35.92	(76)
East	0.9x	0.77	x	4.8	x	16.15	x	0.63	x	0.7	=	23.69	(76)
West	0.9x	0.77	x	10.94	x	19.64	x	0.63	x	0.7	=	65.67	(80)
West	0.9x	0.77	x	10.94	x	38.42	x	0.63	x	0.7	=	128.46	(80)
West	0.9x	0.77	x	10.94	x	63.27	x	0.63	x	0.7	=	211.55	(80)
West	0.9x	0.77	x	10.94	x	92.28	x	0.63	x	0.7	=	308.53	(80)
West	0.9x	0.77	x	10.94	x	113.09	x	0.63	x	0.7	=	378.11	(80)
West	0.9x	0.77	x	10.94	x	115.77	x	0.63	x	0.7	=	387.07	(80)
West	0.9x	0.77	x	10.94	x	110.22	x	0.63	x	0.7	=	368.5	(80)
West	0.9x	0.77	x	10.94	x	94.68	x	0.63	x	0.7	=	316.54	(80)
West	0.9x	0.77	x	10.94	x	73.59	x	0.63	x	0.7	=	246.04	(80)
West	0.9x	0.77	x	10.94	x	45.59	x	0.63	x	0.7	=	152.42	(80)
West	0.9x	0.77	x	10.94	x	24.49	x	0.63	x	0.7	=	81.88	(80)
West	0.9x	0.77	x	10.94	x	16.15	x	0.63	x	0.7	=	54	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	94.48	184.82	304.37	443.9	544.02	556.9	530.19	455.42	353.99	219.3	117.8	77.69	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	490.51	578.89	685.99	805.46	885.27	878.5	838.96	769.85	678.67	564.24	486.04	463.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.81	0.63	0.47	0.53	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.61	19.79	20.11	20.51	20.81	20.96	20.99	20.98	20.87	20.46	19.96	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.9	0.75	0.53	0.35	0.41	0.71	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.99	18.26	18.72	19.29	19.67	19.82	19.85	19.85	19.75	19.23	18.51	17.95	(90)

fLA = Living area ÷ (4) = 0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.8	19.03	19.42	19.91	20.24	20.39	20.42	20.42	20.32	19.85	19.24	18.77	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.8	19.03	19.42	19.91	20.24	20.39	20.42	20.42	20.32	19.85	19.24	18.77		(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	0.9	0.77	0.58	0.41	0.47	0.75	0.94	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	487.41	571.19	662.49	727.45	684.34	510.68	348.07	362.57	506.56	532.77	480.06	461.05		(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=	1374.83	1336.17	1218.7	1025.75	794.52	533.21	351.87	369.22	574.49	860	1133.99	1367.55		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	660.24	514.07	413.82	214.78	81.97	0	0	0	0	243.46	470.83	674.44		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3273.61 (98)

Space heating requirement in kWh/m²/year 45.84 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)														
	660.24	514.07	413.82	214.78	81.97	0	0	0	0	243.46	470.83	674.44		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	706.14	549.81	442.59	229.71	87.67	0	0	0	0	260.39	503.57	721.32		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3501.19	(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)														
	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82		
Efficiency of water heater													79.8	(216)
(217)m=	87.83	87.57	86.97	85.58	83.16	79.8	79.8	79.8	79.8	85.82	87.31	87.92		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	220.16	194.73	206.17	188.19	190.07	177.38	170.74	186.83	186.33	194.59	201.79	214.76		
Total = Sum(219a)$_{1...12}$ =													2331.74	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3501.19

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Water heating fuel used			2331.74	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			315.9	(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	=	756.26	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	503.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1259.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		1462.79	(272)

TER = 30.18 (273)

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User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 24

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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			2.68	x	1	=	2.68			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			4.16	x1/[1/(1.3)+ 0.04]		=	5.14			(27)
Windows Type 2			6.05	x1/[1/(1.3)+ 0.04]		=	7.48			(27)
Windows Type 3			2.85	x1/[1/(1.3)+ 0.04]		=	3.52			(27)
Floor			71.42	x	0.11	=	7.8562			(28)
Walls Type1	79.91	18.48	61.43	x	0.15	=	9.21			(29)
Walls Type2	18.41	0	18.41	x	0.13	=	2.43			(29)
Total area of elements, m²			169.74							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.06 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8973.96 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 12.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 53.36 (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=	19.78	19.54	19.31	18.14	17.91	16.75	16.75	16.51	17.21	17.91	18.38	18.84	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.14	72.91	72.67	71.51	71.27	70.11	70.11	69.88	70.58	71.27	71.74	72.21	

Average = Sum(39)$_{1…12}$ /12= 71.45 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.02	1.02	1	1	0.98	0.98	0.98	0.99	1	1	1.01

Average = Sum(40)$_{1…12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32

(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	

Output from water heater (annual)$_{1...12}$ 1926.82 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.22	16.18	13.16	9.96	7.45	6.29	6.79	8.83	11.85	15.05	17.57	18.73	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	389.43	387.44	374.93	354.81	334.45	314.78	301.96	307.65	317.96	338.28	361.63	379.06	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	4.16	x	19.64	x	0.5	x	0.7	=	19.82	(76)
East	0.9x	0.77	x	4.16	x	38.42	x	0.5	x	0.7	=	38.77	(76)
East	0.9x	0.77	x	4.16	x	63.27	x	0.5	x	0.7	=	63.84	(76)
East	0.9x	0.77	x	4.16	x	92.28	x	0.5	x	0.7	=	93.11	(76)
East	0.9x	0.77	x	4.16	x	113.09	x	0.5	x	0.7	=	114.11	(76)

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East	0.9x	0.77	x	4.16	x	115.77	x	0.5	x	0.7	=	116.81	(76)
East	0.9x	0.77	x	4.16	x	110.22	x	0.5	x	0.7	=	111.21	(76)
East	0.9x	0.77	x	4.16	x	94.68	x	0.5	x	0.7	=	95.53	(76)
East	0.9x	0.77	x	4.16	x	73.59	x	0.5	x	0.7	=	74.25	(76)
East	0.9x	0.77	x	4.16	x	45.59	x	0.5	x	0.7	=	46	(76)
East	0.9x	0.77	x	4.16	x	24.49	x	0.5	x	0.7	=	24.71	(76)
East	0.9x	0.77	x	4.16	x	16.15	x	0.5	x	0.7	=	16.3	(76)
South	0.9x	0.77	x	2.85	x	46.75	x	0.5	x	0.7	=	32.32	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.5	x	0.7	=	52.93	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.5	x	0.7	=	67.42	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.5	x	0.7	=	76.2	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.5	x	0.7	=	79.41	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.5	x	0.7	=	76.42	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.5	x	0.7	=	74.67	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.5	x	0.7	=	72.51	(78)
South	0.9x	0.77	x	2.85	x	101.89	x	0.5	x	0.7	=	70.43	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.5	x	0.7	=	57.09	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.5	x	0.7	=	38.31	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.5	x	0.7	=	27.93	(78)
West	0.9x	0.77	x	6.05	x	19.64	x	0.5	x	0.7	=	28.82	(80)
West	0.9x	0.77	x	6.05	x	38.42	x	0.5	x	0.7	=	56.38	(80)
West	0.9x	0.77	x	6.05	x	63.27	x	0.5	x	0.7	=	92.85	(80)
West	0.9x	0.77	x	6.05	x	92.28	x	0.5	x	0.7	=	135.41	(80)
West	0.9x	0.77	x	6.05	x	113.09	x	0.5	x	0.7	=	165.96	(80)
West	0.9x	0.77	x	6.05	x	115.77	x	0.5	x	0.7	=	169.88	(80)
West	0.9x	0.77	x	6.05	x	110.22	x	0.5	x	0.7	=	161.74	(80)
West	0.9x	0.77	x	6.05	x	94.68	x	0.5	x	0.7	=	138.93	(80)
West	0.9x	0.77	x	6.05	x	73.59	x	0.5	x	0.7	=	107.99	(80)
West	0.9x	0.77	x	6.05	x	45.59	x	0.5	x	0.7	=	66.9	(80)
West	0.9x	0.77	x	6.05	x	24.49	x	0.5	x	0.7	=	35.94	(80)
West	0.9x	0.77	x	6.05	x	16.15	x	0.5	x	0.7	=	23.7	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	80.96	148.07	224.11	304.73	359.47	363.12	347.61	306.97	252.67	169.99	98.95	67.92	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	470.39	535.51	599.05	659.53	693.93	677.9	649.57	614.62	570.62	508.27	460.58	446.98	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.9	0.83	0.72	0.58	0.44	0.48	0.68	0.86	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.98	19.24	19.65	20.16	20.58	20.85	20.95	20.93	20.74	20.2	19.51	18.94	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.06	20.07	20.07	20.08	20.09	20.1	20.1	20.1	20.09	20.09	20.08	20.07	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.89	0.81	0.68	0.51	0.36	0.4	0.62	0.84	0.93	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.36	17.73	18.32	19.05	19.61	19.96	20.06	20.05	19.83	19.11	18.13	17.31	(90)

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.98	18.31	18.83	19.48	19.98	20.3	20.4	20.39	20.18	19.53	18.66	17.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.98	18.31	18.83	19.48	19.98	20.3	20.4	20.39	20.18	19.53	18.66	17.93	(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=	0.93	0.91	0.86	0.79	0.68	0.53	0.39	0.43	0.63	0.82	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	438.68	486.02	517.83	520.07	470.46	358.57	254.12	262.55	358.91	415.37	417.66	420	(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=	1000.68	977.71	896.22	756.27	590.03	399.45	266.52	278.77	429.06	636.37	829.44	991.71	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	418.13	330.41	281.52	170.07	88.96	0	0	0	0	164.43	296.48	425.35	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2175.35 (98)

Space heating requirement in kWh/m²/year 30.46 (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	659.03	518.81	531.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.83	0.89	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	549.61	459.33	461.27	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	866.26	831.72	791.94	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	227.99	277.06	246.02	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 751.07 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.74 (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	41.95	50.98	45.27	0	0	0	0

	Total = Sum(107) =	138.21	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.94	(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 heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2175.35	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2284.12	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1926.82	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	43.07	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	20.98	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		161.41	(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) =	161.41	(331)
Energy for lighting (calculated in Appendix L)		321.76	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-482.91	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		289	(367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	773.52	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	22.35	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	795.88	(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) =			795.88	(376)
CO2 associated with space cooling	(315) x	0.52	=	10.89	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	83.77	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	166.99	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-250.63	(380)
Total CO2, kg/year	sum of (376)…(382) =			806.9	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			11.3	(384)
EI rating (section 14)				90.71	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 24

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.85	(2a) =	203.55	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.55	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(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			2.68	x	1	=	2.68			(26)
Doors Type 2			2.74	x	1	=	2.74			(26)
Windows Type 1			3.96	x1/[1/(1.4)+ 0.04]		=	5.25			(27)
Windows Type 2			5.76	x1/[1/(1.4)+ 0.04]		=	7.64			(27)
Windows Type 3			2.71	x1/[1/(1.4)+ 0.04]		=	3.59			(27)
Floor			71.42	x	0.13	=	9.284599			(28)
Walls Type1	79.91	17.85	62.06	x	0.18	=	11.17			(29)
Walls Type2	18.41	0	18.41	x	0.18	=	3.31			(29)
Total area of elements, m²			169.74							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8982.78 (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 10.1 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.77 (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=	40.96	40.68	40.39	39.08	38.83	37.68	37.68	37.47	38.12	38.83	39.33	39.85	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	96.73	96.44	96.16	94.84	94.6	93.45	93.45	93.23	93.89	94.6	95.09	95.62	

Average = Sum(39)$_{1…12}$ /12= 94.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.35	1.35	1.35	1.33	1.32	1.31	1.31	1.31	1.31	1.32	1.33	1.34

Average = Sum(40)$_{1…12}$ /12= 1.33 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19

Total = Sum(44)$_{1…12}$ = 1060.23 (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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58

Total = Sum(45)$_{1…12}$ = 1390.13 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.84 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	

Output from water heater (annual)$_{1...12}$ 1969.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.37	16.31	13.27	10.04	7.51	6.34	6.85	8.9	11.95	15.17	17.71	18.88	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	396.52	394.5	381.97	361.82	341.45	321.77	308.95	314.66	324.99	345.34	368.71	386.14	(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)	
East	0.9x	0.77	x	3.96	x	19.64	x	0.63	x	0.7	=	23.77	(76)
East	0.9x	0.77	x	3.96	x	38.42	x	0.63	x	0.7	=	46.5	(76)
East	0.9x	0.77	x	3.96	x	63.27	x	0.63	x	0.7	=	76.57	(76)
East	0.9x	0.77	x	3.96	x	92.28	x	0.63	x	0.7	=	111.68	(76)
East	0.9x	0.77	x	3.96	x	113.09	x	0.63	x	0.7	=	136.87	(76)

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East	0.9x	0.77	x	3.96	x	115.77	x	0.63	x	0.7	=	140.11	(76)
East	0.9x	0.77	x	3.96	x	110.22	x	0.63	x	0.7	=	133.39	(76)
East	0.9x	0.77	x	3.96	x	94.68	x	0.63	x	0.7	=	114.58	(76)
East	0.9x	0.77	x	3.96	x	73.59	x	0.63	x	0.7	=	89.06	(76)
East	0.9x	0.77	x	3.96	x	45.59	x	0.63	x	0.7	=	55.17	(76)
East	0.9x	0.77	x	3.96	x	24.49	x	0.63	x	0.7	=	29.64	(76)
East	0.9x	0.77	x	3.96	x	16.15	x	0.63	x	0.7	=	19.55	(76)
South	0.9x	0.77	x	2.71	x	46.75	x	0.63	x	0.7	=	38.72	(78)
South	0.9x	0.77	x	2.71	x	76.57	x	0.63	x	0.7	=	63.41	(78)
South	0.9x	0.77	x	2.71	x	97.53	x	0.63	x	0.7	=	80.78	(78)
South	0.9x	0.77	x	2.71	x	110.23	x	0.63	x	0.7	=	91.3	(78)
South	0.9x	0.77	x	2.71	x	114.87	x	0.63	x	0.7	=	95.14	(78)
South	0.9x	0.77	x	2.71	x	110.55	x	0.63	x	0.7	=	91.56	(78)
South	0.9x	0.77	x	2.71	x	108.01	x	0.63	x	0.7	=	89.46	(78)
South	0.9x	0.77	x	2.71	x	104.89	x	0.63	x	0.7	=	86.87	(78)
South	0.9x	0.77	x	2.71	x	101.89	x	0.63	x	0.7	=	84.38	(78)
South	0.9x	0.77	x	2.71	x	82.59	x	0.63	x	0.7	=	68.4	(78)
South	0.9x	0.77	x	2.71	x	55.42	x	0.63	x	0.7	=	45.9	(78)
South	0.9x	0.77	x	2.71	x	40.4	x	0.63	x	0.7	=	33.46	(78)
West	0.9x	0.77	x	5.76	x	19.64	x	0.63	x	0.7	=	34.57	(80)
West	0.9x	0.77	x	5.76	x	38.42	x	0.63	x	0.7	=	67.63	(80)
West	0.9x	0.77	x	5.76	x	63.27	x	0.63	x	0.7	=	111.38	(80)
West	0.9x	0.77	x	5.76	x	92.28	x	0.63	x	0.7	=	162.44	(80)
West	0.9x	0.77	x	5.76	x	113.09	x	0.63	x	0.7	=	199.08	(80)
West	0.9x	0.77	x	5.76	x	115.77	x	0.63	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	5.76	x	110.22	x	0.63	x	0.7	=	194.02	(80)
West	0.9x	0.77	x	5.76	x	94.68	x	0.63	x	0.7	=	166.66	(80)
West	0.9x	0.77	x	5.76	x	73.59	x	0.63	x	0.7	=	129.54	(80)
West	0.9x	0.77	x	5.76	x	45.59	x	0.63	x	0.7	=	80.25	(80)
West	0.9x	0.77	x	5.76	x	24.49	x	0.63	x	0.7	=	43.11	(80)
West	0.9x	0.77	x	5.76	x	16.15	x	0.63	x	0.7	=	28.43	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	97.06	177.54	268.74	365.42	431.09	435.46	416.87	368.11	302.98	203.82	118.64	81.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	493.58	572.05	650.71	727.24	772.54	757.23	725.82	682.77	627.97	549.16	487.35	467.58	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.55	0.6	0.83	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.75	20.04	20.42	20.73	20.92	20.98	20.97	20.84	20.42	19.93	19.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.8	19.8	19.8	19.82	19.82	19.83	19.83	19.84	19.83	19.82	19.82	19.81	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.93	0.82	0.61	0.41	0.46	0.75	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.93	18.18	18.61	19.15	19.56	19.79	19.83	19.83	19.7	19.17	18.46	17.9	(90)

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.56	18.78	19.16	19.63	20.01	20.22	20.27	20.27	20.14	19.65	19.03	18.53	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.56	18.78	19.16	19.63	20.01	20.22	20.27	20.27	20.14	19.65	19.03	18.53	(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	0.92	0.83	0.65	0.46	0.51	0.77	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	490.19	564.39	631.26	672.7	637.47	490.1	336.88	350.85	486.56	519.84	480.95	465.02	(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=	1379.25	1339.02	1216.99	1018.04	786.28	525.37	343	360.46	567.08	855.95	1134.06	1370.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	661.47	520.55	435.79	248.65	110.71	0	0	0	0	250.07	470.24	673.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3371.06 (98)

Space heating requirement in kWh/m²/year 47.2 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	661.47	520.55	435.79	248.65	110.71	0	0	0	0	250.07	470.24	673.59	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	707.45	556.74	466.08	265.94	118.41	0	0	0	0	267.45	502.93	720.42	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3605.41 (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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Water heating

Output from water heater (calculated above)

	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82		
Efficiency of water heater													79.8	(216)
(217)m=	87.84	87.6	87.1	85.97	83.89	79.8	79.8	79.8	79.8	85.89	87.31	87.92		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	220.15	194.67	205.89	187.34	188.42	177.38	170.74	186.83	186.33	194.43	201.8	214.77		
								Total = Sum(219a)$_{1...12}$ =					2328.74	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3605.41	
Water heating fuel used			2328.74	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			324.37	(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	=	778.77	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	503.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1281.78	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	168.35	(268)
Total CO2, kg/year			sum of (265)…(271) =		1489.05	(272)

TER = 30.72 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 33

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	2.75	(2a) =	136.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		136.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			2.12	x	1	=	2.12			(26)
Windows Type 1			3.16	x1/[1/(1.3)+ 0.04]		=	3.9			(27)
Windows Type 2			8.72	x1/[1/(1.3)+ 0.04]		=	10.78			(27)
Walls Type1	40.81	14	26.81	x	0.15	=	4.02			(29)
Walls Type2	10.2	0	10.2	x	0.14	=	1.44			(29)
Walls Type3	7.56	0	7.56	x	0.13	=	1			(29)
Roof	49.68	0	49.68	x	0.11	=	5.46			(30)
Total area of elements, m²			108.25							(31)
Party wall			18.97	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) = 28.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1450.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.06 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 38.78 (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=	12.63	12.48	12.34	11.62	11.48	10.76	10.76	10.61	11.05	11.48	11.76	12.05	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	51.41	51.27	51.12	50.4	50.26	49.54	49.54	49.4	49.83	50.26	50.55	50.83

Average = Sum(39)$_{1…12}$ /12= 50.37 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.03	1.03	1.03	1.01	1.01	1	1	0.99	1	1.01	1.02	1.02

Average = Sum(40)$_{1…12}$ /12= 1.01 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.12 (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=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)$_{1…12}$ = 889.39 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	166.49	146.91	154.7	139.24	136.86	122.88	118.57	129.34	128.87	144.36	151.93	162.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	166.49	146.91	154.7	139.24	136.86	122.88	118.57	129.34	128.87	144.36	151.93	162.67	

Output from water heater (annual)$_{1...12}$ 1702.83 (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=	76.67	68.1	72.75	66.92	66.82	61.48	60.74	64.32	63.47	69.31	71.14	75.4	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.05	11.59	9.43	7.14	5.34	4.5	4.87	6.33	8.49	10.78	12.58	13.41	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	103.05	101.33	97.78	92.95	89.81	85.39	81.63	86.45	88.15	93.16	98.81	101.34	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	310.71	309.06	299.51	284.24	269.01	254.09	244.24	248.99	256.69	272.14	289.87	302.91	(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)	
East	0.9x	0.77	x	3.16	x	19.64	x	0.5	x	0.7	=	15.05	(76)
East	0.9x	0.77	x	3.16	x	38.42	x	0.5	x	0.7	=	29.45	(76)
East	0.9x	0.77	x	3.16	x	63.27	x	0.5	x	0.7	=	48.5	(76)
East	0.9x	0.77	x	3.16	x	92.28	x	0.5	x	0.7	=	70.73	(76)
East	0.9x	0.77	x	3.16	x	113.09	x	0.5	x	0.7	=	86.68	(76)

East	0.9x	0.77	x	3.16	x	115.77	x	0.5	x	0.7	=	88.73	(76)
East	0.9x	0.77	x	3.16	x	110.22	x	0.5	x	0.7	=	84.48	(76)
East	0.9x	0.77	x	3.16	x	94.68	x	0.5	x	0.7	=	72.57	(76)
East	0.9x	0.77	x	3.16	x	73.59	x	0.5	x	0.7	=	56.4	(76)
East	0.9x	0.77	x	3.16	x	45.59	x	0.5	x	0.7	=	34.94	(76)
East	0.9x	0.77	x	3.16	x	24.49	x	0.5	x	0.7	=	18.77	(76)
East	0.9x	0.77	x	3.16	x	16.15	x	0.5	x	0.7	=	12.38	(76)
West	0.9x	0.77	x	8.72	x	19.64	x	0.5	x	0.7	=	41.54	(80)
West	0.9x	0.77	x	8.72	x	38.42	x	0.5	x	0.7	=	81.26	(80)
West	0.9x	0.77	x	8.72	x	63.27	x	0.5	x	0.7	=	133.82	(80)
West	0.9x	0.77	x	8.72	x	92.28	x	0.5	x	0.7	=	195.18	(80)
West	0.9x	0.77	x	8.72	x	113.09	x	0.5	x	0.7	=	239.2	(80)
West	0.9x	0.77	x	8.72	x	115.77	x	0.5	x	0.7	=	244.86	(80)
West	0.9x	0.77	x	8.72	x	110.22	x	0.5	x	0.7	=	233.12	(80)
West	0.9x	0.77	x	8.72	x	94.68	x	0.5	x	0.7	=	200.24	(80)
West	0.9x	0.77	x	8.72	x	73.59	x	0.5	x	0.7	=	155.64	(80)
West	0.9x	0.77	x	8.72	x	45.59	x	0.5	x	0.7	=	96.42	(80)
West	0.9x	0.77	x	8.72	x	24.49	x	0.5	x	0.7	=	51.8	(80)
West	0.9x	0.77	x	8.72	x	16.15	x	0.5	x	0.7	=	34.16	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	56.59	110.71	182.32	265.9	325.88	333.59	317.59	272.81	212.05	131.36	70.57	46.54	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	367.3	419.77	481.83	550.14	594.88	587.68	561.83	521.8	468.74	403.5	360.44	349.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.94	0.92	0.87	0.78	0.64	0.49	0.37	0.41	0.62	0.83	0.92	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.08	19.35	19.79	20.31	20.68	20.9	20.97	20.95	20.79	20.28	19.6	19.04	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.05	20.06	20.06	20.07	20.07	20.09	20.09	20.09	20.08	20.07	20.07	20.06	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.91	0.85	0.75	0.6	0.43	0.3	0.34	0.56	0.8	0.91	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.5	17.88	18.51	19.23	19.73	19.99	20.06	20.06	19.88	19.22	18.26	17.44	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.42	18.74	19.25	19.86	20.28	20.52	20.59	20.58	20.41	19.84	19.04	18.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.42	18.74	19.25	19.86	20.28	20.52	20.59	20.58	20.41	19.84	19.04	18.37	(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=	0.92	0.89	0.84	0.74	0.61	0.46	0.34	0.38	0.58	0.79	0.89	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	337.94	373.96	402.87	407.09	363.89	271.47	190.91	197.28	272.08	318.08	320.98	324.26	(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=	725.79	709.33	651.92	552.22	431.28	293.07	197.48	206.28	314.41	464.22	603.33	720.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	288.56	225.37	185.29	104.49	50.14	0	0	0	0	108.73	203.29	294.51	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1460.38 (98)

Space heating requirement in kWh/m²/year 29.4 (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	465.69	366.61	375.42	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.88	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	410.48	337.41	339.42	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	740.05	708.86	662.71	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	237.3	276.37	240.53	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 754.19 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.83 (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	49.21	57.31	49.88	0	0	0	0

Total = Sum(107)$_{6...8}$ = 156.4 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 3.15 (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)

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The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1460.38	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1533.4	(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		1702.83	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1787.97	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.21	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	23.74	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		108.34	(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) =	108.34	(331)
Energy for lighting (calculated in Appendix L)		230.5	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-482.91	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				289	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	596.47	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	17.24	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	613.71	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				613.71	(376)
CO2 associated with space cooling	(315) x		0.52	=	12.32	(377)

DER WorkSheet: New dwelling design stage

CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	56.23	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	119.63	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-250.63	(380)
Total CO2, kg/year	sum of (376)…(382) =			551.25	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			11.1	(384)
EI rating (section 14)				92.2	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 33

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	2.75	(2a) =	136.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1	=	2.12			(26)
Windows Type 1			2.74	x1/[1/(1.4)+ 0.04]		=	3.63			(27)
Windows Type 2			7.56	x1/[1/(1.4)+ 0.04]		=	10.02			(27)
Walls Type1	40.81	12.42	28.39	x	0.18	=	5.11			(29)
Walls Type2	10.2	0	10.2	x	0.18	=	1.84			(29)
Walls Type3	7.56	0	7.56	x	0.18	=	1.36			(29)
Roof	49.68	0	49.68	x	0.13	=	6.46			(30)
Total area of elements, m²			108.25							(31)
Party wall			18.97	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) = 30.54 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1472.62 (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 12.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 43.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	26.7	26.54	26.38	25.64	25.5	24.85	24.85	24.73	25.1	25.5	25.78	26.08	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	69.89	69.73	69.57	68.83	68.69	68.04	68.04	67.92	68.29	68.69	68.97	69.27	

Average = Sum(39)$_{1…12}$ /12= 68.83 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.38	1.37	1.37	1.37	1.37	1.38	1.39	1.39

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.12 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Total = Sum(44)$_{1…12}$ = 889.39 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.84 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.15	150.22	158.36	142.79	140.52	126.42	122.23	133	132.41	148.02	155.48	166.33		(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)

Output from water heater

(64)m=	170.15	150.22	158.36	142.79	140.52	126.42	122.23	133	132.41	148.02	155.48	166.33		
									Output from water heater (annual)$_{1…12}$				1745.93	(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=	79.59	70.74	75.68	69.75	69.74	64.31	63.66	67.24	66.31	72.24	73.97	78.33		(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.1	11.64	9.46	7.16	5.36	4.52	4.89	6.35	8.52	10.82	12.63	13.46	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)
Water heating gains (Table 5)													
(72)m=	106.98	105.27	101.71	96.88	93.74	89.32	85.57	90.38	92.09	97.09	102.74	105.28	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	317.7	316.04	306.48	291.2	275.96	261.04	251.19	255.95	263.66	279.11	296.86	309.89	(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)	
East	0.9x	0.77	x	2.74	x	19.64	x	0.63	x	0.7	=	16.45	(76)
East	0.9x	0.77	x	2.74	x	38.42	x	0.63	x	0.7	=	32.17	(76)
East	0.9x	0.77	x	2.74	x	63.27	x	0.63	x	0.7	=	52.98	(76)
East	0.9x	0.77	x	2.74	x	92.28	x	0.63	x	0.7	=	77.27	(76)
East	0.9x	0.77	x	2.74	x	113.09	x	0.63	x	0.7	=	94.7	(76)

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East	0.9x	0.77	x	2.74	x	115.77	x	0.63	x	0.7	=	96.94	(76)
East	0.9x	0.77	x	2.74	x	110.22	x	0.63	x	0.7	=	92.29	(76)
East	0.9x	0.77	x	2.74	x	94.68	x	0.63	x	0.7	=	79.28	(76)
East	0.9x	0.77	x	2.74	x	73.59	x	0.63	x	0.7	=	61.62	(76)
East	0.9x	0.77	x	2.74	x	45.59	x	0.63	x	0.7	=	38.18	(76)
East	0.9x	0.77	x	2.74	x	24.49	x	0.63	x	0.7	=	20.51	(76)
East	0.9x	0.77	x	2.74	x	16.15	x	0.63	x	0.7	=	13.52	(76)
West	0.9x	0.77	x	7.56	x	19.64	x	0.63	x	0.7	=	45.38	(80)
West	0.9x	0.77	x	7.56	x	38.42	x	0.63	x	0.7	=	88.77	(80)
West	0.9x	0.77	x	7.56	x	63.27	x	0.63	x	0.7	=	146.19	(80)
West	0.9x	0.77	x	7.56	x	92.28	x	0.63	x	0.7	=	213.21	(80)
West	0.9x	0.77	x	7.56	x	113.09	x	0.63	x	0.7	=	261.29	(80)
West	0.9x	0.77	x	7.56	x	115.77	x	0.63	x	0.7	=	267.48	(80)
West	0.9x	0.77	x	7.56	x	110.22	x	0.63	x	0.7	=	254.65	(80)
West	0.9x	0.77	x	7.56	x	94.68	x	0.63	x	0.7	=	218.74	(80)
West	0.9x	0.77	x	7.56	x	73.59	x	0.63	x	0.7	=	170.02	(80)
West	0.9x	0.77	x	7.56	x	45.59	x	0.63	x	0.7	=	105.33	(80)
West	0.9x	0.77	x	7.56	x	24.49	x	0.63	x	0.7	=	56.58	(80)
West	0.9x	0.77	x	7.56	x	16.15	x	0.63	x	0.7	=	37.32	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	61.82	120.94	199.17	290.48	355.99	364.42	346.95	298.02	231.65	143.51	77.09	50.84	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	379.52	436.98	505.65	581.68	631.96	625.47	598.14	553.97	495.3	422.62	373.94	360.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.82	0.65	0.49	0.54	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.57	19.75	20.07	20.47	20.78	20.94	20.99	20.98	20.86	20.44	19.93	19.54	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.9	0.76	0.54	0.36	0.41	0.7	0.93	0.99	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.9	18.16	18.61	19.18	19.57	19.75	19.78	19.78	19.68	19.15	18.43	17.86	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.87	19.08	19.46	19.92	20.27	20.44	20.48	20.48	20.36	19.9	19.3	18.84	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.87	19.08	19.46	19.92	20.27	20.44	20.48	20.48	20.36	19.9	19.3	18.84	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.9	0.78	0.6	0.43	0.49	0.75	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	376.05	429.6	486.33	525.22	494.96	375.74	259.92	270.08	371.26	395.94	367.69	358.05	(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=	1018.33	989.02	901.36	758.82	588.84	397.55	264.07	276.85	427.65	638.63	841.65	1013.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	477.86	375.94	308.78	168.2	69.84	0	0	0	0	180.56	341.25	487.92	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2410.35 (98)

Space heating requirement in kWh/m²/year 48.52 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	477.86	375.94	308.78	168.2	69.84	0	0	0	0	180.56	341.25	487.92	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	511.08	402.07	330.25	179.89	74.7	0	0	0	0	193.11	364.97	521.84	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2577.91 (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)													
	170.15	150.22	158.36	142.79	140.52	126.42	122.23	133	132.41	148.02	155.48	166.33	
Efficiency of water heater												79.8	(216)
(217)m=	87.42	87.16	86.57	85.25	83.06	79.8	79.8	79.8	79.8	85.34	86.85	87.52	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	194.63	172.34	182.94	167.49	169.18	158.42	153.17	166.67	165.93	173.44	179.01	190.06	

Total = Sum(219a)$_{1...12}$ = 2073.27 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2577.91

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Water heating fuel used			2073.27	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			231.36	(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	=	556.83	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	447.83	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1004.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	120.07	(268)
Total CO2, kg/year		sum of (265)…(271) =		1163.65	(272)

TER = 34.55 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 34

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.75	(2a) =	196.4	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		196.4	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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			2.12	x	1	=	2.12			(26)
Windows Type 1			5.74	x1/[1/(1.3)+ 0.04]		=	7.09			(27)
Windows Type 2			14.71	x1/[1/(1.3)+ 0.04]		=	18.18			(27)
Windows Type 3			2.85	x1/[1/(1.3)+ 0.04]		=	3.52			(27)
Walls Type1	77.11	23.3	53.81	x	0.15	=	8.07			(29)
Walls Type2	10.2	2.12	8.08	x	0.14	=	1.14			(29)
Walls Type3	7.56	0	7.56	x	0.13	=	1			(29)
Roof	71.42	0	71.42	x	0.11	=	7.86			(30)
Total area of elements, m²			166.29							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.98 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1615.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.45 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 65.43 (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=	19.08	18.86	18.63	17.51	17.28	16.16	16.16	15.93	16.61	17.28	17.73	18.18	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	84.51	84.29	84.06	82.94	82.72	81.59	81.59	81.37	82.04	82.72	83.17	83.62	

Average = Sum(39)$_{1…12}$ /12= 82.88 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.16	1.16	1.14	1.14	1.14	1.15	1.16	1.16	1.17

Average = Sum(40)$_{1...12}$ /12= 1.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19	
										Total = Sum(44)$_{1...12}$ =		1060.23	(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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58	
										Total = Sum(45)$_{1...12}$ =		1390.13	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	(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=	189.71	167.23	175.66	157.52	154.4	138.01	132.59	145.43	145.15	163.33	172.65	185.16	

Output from water heater (annual)$_{1...12}$ 1926.82 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.39	74.85	79.72	73	72.65	66.51	65.4	69.66	68.88	75.62	78.03	82.88	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114	114	114	114	114	114	114	114	114	114	114	114	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.88	15.88	12.92	9.78	7.31	6.17	6.67	8.67	11.63	14.77	17.24	18.38	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(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=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)
Water heating gains (Table 5)													
(72)m=	113.42	111.38	107.15	101.38	97.64	92.38	87.9	93.64	95.67	101.64	108.37	111.39	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	389.1	387.14	374.69	354.62	334.32	314.66	301.83	307.49	317.74	338	361.3	378.71	(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)	
East	0.9x	0.77	x	5.74	x	19.64	x	0.5	x	0.7	=	27.34	(76)
East	0.9x	0.77	x	5.74	x	38.42	x	0.5	x	0.7	=	53.49	(76)
East	0.9x	0.77	x	5.74	x	63.27	x	0.5	x	0.7	=	88.09	(76)
East	0.9x	0.77	x	5.74	x	92.28	x	0.5	x	0.7	=	128.48	(76)
East	0.9x	0.77	x	5.74	x	113.09	x	0.5	x	0.7	=	157.45	(76)

East	0.9x	0.77	x	5.74	x	115.77	x	0.5	x	0.7	=	161.18	(76)
East	0.9x	0.77	x	5.74	x	110.22	x	0.5	x	0.7	=	153.45	(76)
East	0.9x	0.77	x	5.74	x	94.68	x	0.5	x	0.7	=	131.81	(76)
East	0.9x	0.77	x	5.74	x	73.59	x	0.5	x	0.7	=	102.45	(76)
East	0.9x	0.77	x	5.74	x	45.59	x	0.5	x	0.7	=	63.47	(76)
East	0.9x	0.77	x	5.74	x	24.49	x	0.5	x	0.7	=	34.09	(76)
East	0.9x	0.77	x	5.74	x	16.15	x	0.5	x	0.7	=	22.49	(76)
South	0.9x	0.77	x	2.85	x	46.75	x	0.5	x	0.7	=	32.32	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.5	x	0.7	=	52.93	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.5	x	0.7	=	67.42	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.5	x	0.7	=	76.2	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.5	x	0.7	=	79.41	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.5	x	0.7	=	76.42	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.5	x	0.7	=	74.67	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.5	x	0.7	=	72.51	(78)
South	0.9x	0.77	x	2.85	x	101.89	x	0.5	x	0.7	=	70.43	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.5	x	0.7	=	57.09	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.5	x	0.7	=	38.31	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.5	x	0.7	=	27.93	(78)
West	0.9x	0.77	x	14.71	x	19.64	x	0.5	x	0.7	=	70.07	(80)
West	0.9x	0.77	x	14.71	x	38.42	x	0.5	x	0.7	=	137.08	(80)
West	0.9x	0.77	x	14.71	x	63.27	x	0.5	x	0.7	=	225.75	(80)
West	0.9x	0.77	x	14.71	x	92.28	x	0.5	x	0.7	=	329.25	(80)
West	0.9x	0.77	x	14.71	x	113.09	x	0.5	x	0.7	=	403.5	(80)
West	0.9x	0.77	x	14.71	x	115.77	x	0.5	x	0.7	=	413.06	(80)
West	0.9x	0.77	x	14.71	x	110.22	x	0.5	x	0.7	=	393.25	(80)
West	0.9x	0.77	x	14.71	x	94.68	x	0.5	x	0.7	=	337.79	(80)
West	0.9x	0.77	x	14.71	x	73.59	x	0.5	x	0.7	=	262.56	(80)
West	0.9x	0.77	x	14.71	x	45.59	x	0.5	x	0.7	=	162.66	(80)
West	0.9x	0.77	x	14.71	x	24.49	x	0.5	x	0.7	=	87.37	(80)
West	0.9x	0.77	x	14.71	x	16.15	x	0.5	x	0.7	=	57.63	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	129.74	243.5	381.27	533.92	640.36	650.66	621.36	542.12	435.44	283.22	159.78	108.04	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	518.83	630.64	755.95	888.55	974.68	965.32	923.2	849.6	753.18	621.22	521.08	486.75	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.95	0.92	0.86	0.76	0.63	0.49	0.37	0.41	0.61	0.83	0.93	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.73	19.08	19.6	20.19	20.62	20.87	20.95	20.94	20.74	20.14	19.32	18.67	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.97	19.97	19.97	19.96	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.91	0.85	0.73	0.59	0.42	0.29	0.33	0.55	0.8	0.91	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.92	17.42	18.16	18.98	19.54	19.85	19.94	19.93	19.72	18.93	17.79	16.84	(90)

fLA = Living area ÷ (4) = 0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.83	18.26	18.88	19.59	20.09	20.36	20.45	20.44	20.23	19.54	18.56	17.76	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.83	18.26	18.88	19.59	20.09	20.36	20.45	20.44	20.23	19.54	18.56	17.76	(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=	0.92	0.89	0.82	0.72	0.59	0.45	0.33	0.37	0.57	0.78	0.89	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	479.13	558.99	622.6	640.74	576.62	430.6	301.51	311.2	427.22	485.65	465.29	453.86	(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=	1143.66	1125.71	1041.12	886.83	693.65	470.11	314.03	328.34	503.12	739.5	953.34	1133.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	494.41	380.84	311.38	177.19	87.07	0	0	0	0	188.86	351.4	505.94	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2497.08 (98)

Space heating requirement in kWh/m²/year 34.96 (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	766.96	603.78	618.39	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.86	0.9	0.88	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	660.56	545.24	546.25	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1202.06	1151.38	1066.38	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	389.88	450.97	386.97	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 1227.82 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.86 (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	84.15	97.34	83.52	0	0	0	0

Total = Sum(107) = 265.01 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 3.71 (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 heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2497.08	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2621.93	(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		1926.82	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2023.16	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	46.45	(313)
Cooling System Energy Efficiency Ratio		6.59	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	40.23	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		155.75	(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) =	155.75	(331)
Energy for lighting (calculated in Appendix L)		315.81	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-482.91	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		289	(367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	834.19	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	24.11	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	858.3	(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) =			858.3	(376)
CO2 associated with space cooling	(315) x	0.52	=	20.88	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	80.83	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	163.91	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-250.63	(380)
Total CO2, kg/year	sum of (376)…(382) =			873.28	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			12.23	(384)
EI rating (section 14)				89.95	(385)

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User Details:

Assessor Name:	Lindsey Arnott	**Stroma Number:**	STRO035000
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.9

Property Address: Flat 34

Address : The Alders, Aldrington Road, SW16 1TW

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.42	(1a) x	2.75	(2a) =	196.4	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.42	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		196.4	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.47	0.46	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.42	0.44

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1	=	2.12			(26)
Windows Type 1			3.88	x1/[1/(1.4)+ 0.04]		=	5.14			(27)
Windows Type 2			9.93	x1/[1/(1.4)+ 0.04]		=	13.16			(27)
Windows Type 3			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Walls Type1	77.11	15.73	61.38	x	0.18	=	11.05			(29)
Walls Type2	10.2	2.12	8.08	x	0.18	=	1.45			(29)
Walls Type3	7.56	0	7.56	x	0.18	=	1.36			(29)
Roof	71.42	0	71.42	x	0.13	=	9.28			(30)
Total area of elements, m²			166.29							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 46.12 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1721.06 (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 21.1 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 67.22 (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=	39.72	39.43	39.16	37.85	37.6	36.47	36.47	36.26	36.9	37.6	38.1	38.62	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	106.94	106.65	106.38	105.07	104.82	103.69	103.69	103.47	104.12	104.82	105.32	105.84	

Average = Sum(39)$_{1…12}$ /12= 105.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.5	1.49	1.49	1.47	1.47	1.45	1.45	1.45	1.46	1.47	1.47	1.48

Average = Sum(40)$_{1…12}$ /12= 1.47 (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)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.28 (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 88.35 (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=	97.19	93.65	90.12	86.59	83.05	79.52	79.52	83.05	86.59	90.12	93.65	97.19	
										Total = Sum(44)$_{1…12}$ =		1060.23	(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=	144.13	126.05	130.08	113.4	108.81	93.9	87.01	99.85	101.04	117.75	128.53	139.58	
										Total = Sum(45)$_{1…12}$ =		1390.13	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.62	18.91	19.51	17.01	16.32	14.08	13.05	14.98	15.16	17.66	19.28	20.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.84 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.84 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	(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=	193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82	

Output from water heater (annual)$_{1...12}$ 1969.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	87.32	77.49	82.64	75.83	75.57	69.34	68.32	72.59	71.72	78.55	80.86	85.8	(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=	114	114	114	114	114	114	114	114	114	114	114	114	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.89	15.89	12.92	9.78	7.31	6.17	6.67	8.67	11.64	14.78	17.25	18.39	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	200.59	202.67	197.42	186.26	172.16	158.91	150.06	147.98	153.23	164.39	178.49	191.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	-91.2	(71)

Water heating gains (Table 5)

(72)m=	117.36	115.32	111.08	105.32	101.58	96.31	91.83	97.57	99.61	105.57	112.31	115.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	396.04	394.08	381.63	361.56	341.25	321.6	308.77	314.43	324.68	344.94	368.24	385.65	(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)	
East	0.9x	0.77	x	3.88	x	19.64	x	0.63	x	0.7	=	23.29	(76)
East	0.9x	0.77	x	3.88	x	38.42	x	0.63	x	0.7	=	45.56	(76)
East	0.9x	0.77	x	3.88	x	63.27	x	0.63	x	0.7	=	75.03	(76)
East	0.9x	0.77	x	3.88	x	92.28	x	0.63	x	0.7	=	109.42	(76)
East	0.9x	0.77	x	3.88	x	113.09	x	0.63	x	0.7	=	134.1	(76)

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East	0.9x	0.77	x	3.88	x	115.77	x	0.63	x	0.7	=	137.28	(76)
East	0.9x	0.77	x	3.88	x	110.22	x	0.63	x	0.7	=	130.69	(76)
East	0.9x	0.77	x	3.88	x	94.68	x	0.63	x	0.7	=	112.26	(76)
East	0.9x	0.77	x	3.88	x	73.59	x	0.63	x	0.7	=	87.26	(76)
East	0.9x	0.77	x	3.88	x	45.59	x	0.63	x	0.7	=	54.06	(76)
East	0.9x	0.77	x	3.88	x	24.49	x	0.63	x	0.7	=	29.04	(76)
East	0.9x	0.77	x	3.88	x	16.15	x	0.63	x	0.7	=	19.15	(76)
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	27.43	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	44.93	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	57.23	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	64.68	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	67.4	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	64.87	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	63.38	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	61.55	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	59.78	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	48.46	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	32.52	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	23.7	(78)
West	0.9x	0.77	x	9.93	x	19.64	x	0.63	x	0.7	=	59.6	(80)
West	0.9x	0.77	x	9.93	x	38.42	x	0.63	x	0.7	=	116.6	(80)
West	0.9x	0.77	x	9.93	x	63.27	x	0.63	x	0.7	=	192.02	(80)
West	0.9x	0.77	x	9.93	x	92.28	x	0.63	x	0.7	=	280.05	(80)
West	0.9x	0.77	x	9.93	x	113.09	x	0.63	x	0.7	=	343.21	(80)
West	0.9x	0.77	x	9.93	x	115.77	x	0.63	x	0.7	=	351.33	(80)
West	0.9x	0.77	x	9.93	x	110.22	x	0.63	x	0.7	=	334.48	(80)
West	0.9x	0.77	x	9.93	x	94.68	x	0.63	x	0.7	=	287.32	(80)
West	0.9x	0.77	x	9.93	x	73.59	x	0.63	x	0.7	=	223.32	(80)
West	0.9x	0.77	x	9.93	x	45.59	x	0.63	x	0.7	=	138.35	(80)
West	0.9x	0.77	x	9.93	x	24.49	x	0.63	x	0.7	=	74.32	(80)
West	0.9x	0.77	x	9.93	x	16.15	x	0.63	x	0.7	=	49.01	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	110.33	207.08	324.28	454.15	544.71	553.48	528.56	461.13	370.37	240.87	135.87	91.87	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	506.36	601.16	705.9	815.71	885.97	875.08	837.33	775.56	695.04	585.81	504.12	477.52	(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	0.94	0.84	0.68	0.52	0.58	0.82	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.41	19.61	19.94	20.37	20.72	20.92	20.98	20.97	20.81	20.35	19.8	19.39	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(88)m=	19.69	19.69	19.7	19.71	19.71	19.72	19.72	19.73	19.72	19.71	19.71	19.7		(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.78	0.58	0.38	0.44	0.73	0.94	0.99	1		(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.62	17.91	18.39	19	19.45	19.67	19.72	19.71	19.58	18.98	18.2	17.58		(90)

fLA = Living area ÷ (4) = 0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.53	18.77	19.17	19.69	20.09	20.3	20.35	20.35	20.2	19.67	19.01	18.49		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.53	18.77	19.17	19.69	20.09	20.3	20.35	20.35	20.2	19.67	19.01	18.49		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.97	0.91	0.8	0.63	0.45	0.51	0.77	0.94	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	502.6	592.17	681.45	744.13	711.33	548.45	380.62	394.79	534.51	553.03	497.12	474.7		(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=	1521.28	1479.13	1348.28	1133.66	879.19	591.1	389.19	408.39	635.46	950.72	1254.15	1512.74		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	757.9	596.04	496.12	280.46	124.89	0	0	0	0	295.88	545.06	772.3		

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3868.65 (98)

Space heating requirement in kWh/m²/year 54.17 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)														
	757.9	596.04	496.12	280.46	124.89	0	0	0	0	295.88	545.06	772.3		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	810.59	637.47	530.61	299.96	133.57	0	0	0	0	316.45	582.95	825.99		

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 4137.59 (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)

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Water heating

Output from water heater (calculated above)

193.37	170.53	179.32	161.06	158.06	141.55	136.25	149.09	148.69	166.99	176.19	188.82

Efficiency of water heater 79.8 (216)

(217)m=	88.1	87.88	87.39	86.28	84.19	79.8	79.8	79.8	79.8	86.32	87.63	88.18	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.49	194.05	205.2	186.67	187.73	177.38	170.74	186.83	186.33	193.45	201.06	214.14

Total = Sum(219a)$_{1...12}$ = 2323.07 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4137.59	
Water heating fuel used			2323.07	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			315.91	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	893.72	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	501.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1395.5	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.96	(268)
Total CO2, kg/year		sum of (265)…(271) =		1598.38	(272)

TER = 33.13 (273)

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