New & Refurbished Dwellings 179-181 High Street Hampton Hill Hampton



Energy Conservation Statement

May 2016

CLIVE CHAPMAN A R C H I T E C T S SUSTAINABILITY CONSULTANTS

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1.0 Introduction

Clive Chapman Sustainability Consultants have been appointed to carry out a sustainability assessment and energy statement for the new build and refurbishment of the existing buildings at 179-181 High Street Hampton Hill, Hampton.

This scheme proposes extending the retail and residential accommodation to provide a mixed use scheme consisting of one retail unit and ten residential dwellings, incorporating cycle storage, amenity space and landscaping .The works include the refurbishment of the two existing buildings, along with a two and a half storey extension to the rear of the existing buildings and a half storey mansard roof extension to number 181 to provide additional residential accommodation. The ground floor will contain a single retail unit (540m2). The upper floors will form 10 mixed size flats, 3 refurbished and 7 new build.

This report details the sustainability strategy for the residential areas of the development, it is accompanied by a second report from Metropolis Green which deals with the commercial elements of the scheme. The report is structured in three sections; common elements, new build and refurbishment.

For new build dwellings, the London Borough of Richmond upon Thames (LBRuT) current sustainability criteria are listed below. A detailed study has been carried out to assess options to meet these criteria:

- Assessment of the development using the LBRuT Sustainable Construction Checklist (September 2015).
- A maximum water consumption of 105 litres per person, per day.
- A minimum reduction in carbon dioxide emissions of 35% over Building Regulations Approved Document L1A 2010, 2013 edition.
- Endeavour to achieve reductions of 20% of the predicted carbon dioxide emissions by onsite renewable energy generation (Policy DM SD 2).

Developments proposing residential conversions or extensions are also encouraged to comply with the LBRuT Sustainable Construction Checklist. Opportunities for renewable energy generation and high standards of energy and water efficiency are also supported in accordance with the London Plan. The current sustainability criteria are listed below:

- Assessment of the development using the LBRuT Construction Checklist (January 2016).
- An assessment of the proposed refurbishment against BREEAM Domestic Refurbishment, showings how an 'excellent' rating can be achieved. (Core Strategy CP1)

A detailed study has been carried out to assess the options for meeting these criteria, including the compilation of an energy statement. The energy statement discusses the use of renewable technology and proposal for reducing CO2 on the site.

2.0 Design Rationale

The proposed development incorporates a number of different aspects dealing with both refurbishment and new build for commercial and residential premises. The design team has sought to combine these elements in a sustainable manner and achieve maximum project viability.

The approach to sustainability taken for this project is primarily fabric first, this method has been applied to the new build and the refurbished sections. This route conforms to section 5.2 of The Greater London Plan:

Be Lean: Use less energy

This means that buildings should be designed to require less energy in their use. This is achieved through the careful design of building elements in order to maintain the lowest possible u- values throughout the building envelope. Makeups have been carefully engineered so as to optimise u values without compromising on functionality, buildability, or other sustainability concerns such as material sourcing or site pollution.

Be Clean: Supply energy efficiently

Once energy demand has been reduced to the lowest amount possible, energy systems must be specified with consideration to Policy 5.6b of the London Plan which sets out an order of preference. Developments should consider connection to an existing or proposed heat network, if none exist then the appropriateness of a site wide heat network should be considered. As has been discussed within the body of the commercial report, this site does not benefit from any existing or proposed network. Given the size constraints of this development a site heat network would not be appropriate for the site and would not be an efficient solution for the project.

Be Green: Use renewable energy

Renewable energy should be provided to reduce the energy deficit of the building. Technologies should be evaluated in line with the energy hierarchy. Site specific analysis should be carried out on all viable technologies in order to determine the optimum strategy for provision of renewable energy. Assessment of the site has demonstrated that the inclusion of solar PVs provide the greatest gain in renewable energy, for the size and position of the site. An array incorporated on the main roof of the building will serve both the residential and commercial units.

In following this approach the design team have minimised the environmental impact of the development. It should also be noted that a significant amount of the development is refurbishment including the upgrade of existing building fabric. This further enhances the sustainability of the development as these building are currently in use and therefore, given their assumed u-values, using significantly more energy than they will be under the proposed development.

3.0 Transport

The development does not provide any parking, however cycle storage is provided in line with the London plan, I cycle bay per bedroom. The development will also be well served by public transport as follows:

Buses

From bus stops in Station Road and nearby adjoining roads:

- 285 (24hr) to Kingston/Heathrow
- **R68** to Hampton Court/Kew Retail Park via Teddington, Twickenham and Richmond
- **R70** linking the local area with Richmond

Timetables and a map of the bus routes can be found here:

http://content.tfl.gov.uk/bus-route-maps/hampton.pdf

Trains, Overground

From nearby Fullwell Station:

• South West Trains towards, Kingston, Wimbledon and London Waterloo, OR

Sunbury and Shepperton.

For timetables please refer to: https://tfl.gov.uk/?cid=pp004

Cycling and Walking

Following weblinks provide details about cycling and walking routes in London:

https://tfl.gov.uk/modes/cycling/cycling-in-london https://london.cyclestreets.net/ http://walkit.com/cities/london/

4.0 LBRuT Sustainable Construction Checklist

4.1 SCC Requirements, Assumption and Compliance

The Sustainable Construction Checklist states that all developments and applications undertaken in the London Borough of Richmond upon Thames are expected to be assessed against the following seven checklist items:

Category	Score
Minimum Policy Compliance	17
Energy Use and Pollution	6
Transport ¹	7
Biodiversity	13.5
Flooding and Drainage	9
Improving Resource Efficiency	4
Accessibility	1
TOTAL	57.5

Fig1. Result of Sustainable Construction Checklist

An overall score of 57.5 credits will achieve an 'A' rating. Please see Appendix A for the completed Sustainable Construction Checklist.

The SCC has been completed for both the residential and commercial units and this score reflects the outcome of both assessments.

5.0 Renewable Energy Technologies: Feasibility Study

This assessment seeks to determine the suitability of a number of low energy and renewable energy technologies that could be applied or integrated within the proposed development.

5.1 Assessment of Technologies

In accordance with the London Plan, this project adopts The London Mayor's Energy Hierarchy, to: use less energy, use renewable energy and supply energy efficiently. Various high efficiency and renewable energy systems have been considered in line with guidance published by the mayor of London: *Integrating Renewable Energy into New Developments: A toolkit for planners, Developers and Consultants 2004.* The list of technologies covered is not designed to be exhaustive but evaluates the technologies considered to have the highest potential viability for use within the London area.

System	Preliminary Assessment	Decision
Wind generators	Planning and local community issues associated with noise and visual obstruction. Average wind speeds do not achieve the required speed of 6 m/s (www.bwea.com) at the location of the site.	Rejected
Photovoltaic, roof top	 The proposed development has a flat roof which is suitable for the application of photovoltaic panels. They are a commonly used renewable technology and not prohibitively expensive. Low maintenance as there are no moving parts Flat roof gives flexibility for panels to be orientated to face direct south. Can be combined with a green roof to provide both electricity generation and rainwater attenuation (green roof will also help provide cooling to the PV panels). 	Suitable for this site
Solar water heating	The building has a pitched roof that can be used for Solar Thermal tubes. However, solar hot water contributes less significantly towards reducing overall CO2 use than the contribution of Photovoltaic Panels. Solar thermal reduces the use of a gas boiler whereas PVs reduce the electricity consumption of the building. Electricity generation has a larger carbon footprint. In addition, these are small units and solar hot water heating would require additional space for a hot water tank and pipe work.	Rejected

The table below summarises the systems available and their suitability for this project:

Biomass CHP	Biomass CHP is a renewable and energy efficient system providing electricity and space and hot water heating. However, CHP systems are more suitable for applications where there is a high heat demand throughout the year. The building fabric has been designed to be efficient and airtight, and therefore should not require high levels of heating. Additional accessible plant space would also be required to accommodate the equipment. LBRuT does not encourage the use of Biomass	Rejected
Gas Combined Heat and Power (CHP)	Gas CHP units are energy efficient systems generating electricity and providing space and hot water heating. These gas fired systems are available for domestic use, although are more suitable for dwellings with a high annual heat demand. Also these systems are fairly cost prohibitive in comparison with other more efficient renewable technologies.	Rejected
Ground source heat pumps for heating (space and hot water)	Ground area available to each unit is not sufficient to accommodate horizontal pipe system. Ground may be accessible for vertical pipe systems, however the cost is likely to be prohibitive for this development. The most appropriate use would be a low temperature system such as underfloor heating. Secondary heating unit for hot water would be needed.	Rejected
Ground sourced inc. borehole cooling	There is no need of a mechanical cooling system for the proposed dwellings.	Rejected
Biomass heating. Fuels – wood, pellets, woodchips, some industrial waste products.	Biomass heating is a renewable energy technology. However, the system requires extensive space for storing the fuel (chips/pellets).	Rejected
External and Exhaust Air source heat pumps for heating (space and hot water)	Air is an easily accessible means of heating, the most appropriate use would be low temperature system such as under floor heating. However, as it runs on electricity the contribution of the system to the reduction of CO2 use is very low. Systems also require large, and often noisy units to be mounted externally.	Rejected

Micro	Micro CHP units are energy efficient systems generating	Rejected
Combined Heat	electricity and providing space and hot water heating. These	
and Power	gas fired systems are available for domestic use, although	
(CHP)	are more suitable for dwellings with a high annual heat	
	demand. These systems are fairly cost prohibitive in	
	comparison with other alternative renewable technologies.	

Fig2. Evaluation of Renewable Technologies

5.2 Summary

The design team have considered various options for this project and have selected Photovoltaic (PV) panels as the best option for providing renewable energy to the residential scheme. PVs are a commonly used system, not prohibitively expensive and this site has a substantial roof area for the installation of the panels, facing south/southwest. A decision has been made to install high efficiency Sunpower PV modules in order to maximize the power generated per m2. Consideration has been given to the visual impact of the panels particularly from street level. Sufficient panels have been specified to meet the energy demands of both the residential and commercial units, these have been located towards the back of the flat roof in order to reduce any negative aesthetic impact on the surroundings.

From the list of options above, it can also be seen that Solar PV panels are the most suitable renewable energy option for the site as they will provide substantial savings on electricity consumption, and provide low visual / noise impact. They also require very low maintenance throughout their usable life, which is beneficial for serving multiple apartments.

6.0 New Build Energy Conservation Calculations

This section sets out the detailed analysis and results of the annual CO₂ emission calculations of the 'worst case' proposed dwelling. The dwelling has been modelled using the Government Standard Assessment Procedure (SAP) 2012 to determine the impact of building services options and to investigate the use of renewable energy sources, their impact on emissions, and their approximate cost of installation.

The proposed dwelling that has been analysed represents the worst case scenario out of the seven apartments. It has been picked as a worst case scenario based upon the apartments orientation, number of exposed sides, windows, and unit size. The other dwellings not modelled should therefore perform similarly or exceed the results shown in these calculations.

Notes:

Please note that assumptions will have to be confirmed by an M&E Consultant and that any changes will have an impact on the SAP results and therefore the achieved reduction in CO2 and % Renewables.

Option	Specification		DER/TER Variance BREGS L1A 2013 TARGET 0%	% reduction through renewables
Apartment Base Case	-External wall u -Separating Floor u -Separating Wall u	J=0.2 W/m2K J=0.3 W/m ² K J=0 W/m ² K J=0 W/m ² K J=0 W/m ² K J=2.0 W/m ² K	48.06%	n/a
	-Instantaneous Combi boiler 8 (SEDBUK 2009)	8% efficient		

6.1 Options, Calculations and Results: Worst Case Apartment

Apartment Improved Case	Improved build ups/services chosen to reach BRegs L1A 2013	-0.15%	0%
	-Roofu =0.13 W/m²K-External wallu =0.22 W/m²K-Separating Flooru =0 W/m²K-Separating Flooru =0 W/m²K-Windows / Doorsu =1.33 W/m²K-Thermal bridging: 0.0241 calculatedAir tightness: 4.5 m³/hrm²-Instantaneous Combi boiler 89.1% efficient-75% energy efficient lighting		
Apartment Proposed Case	Build ups/services as 'Improved Case' with additional PV to meet LBRuT requirement: 3.2 no. 327 Wp PV panels* Overall approx. 4.8m ² , 0.6kWp, mounted at 30° angle on sedum planted flat roof facing south.	-43.66%	20.89%

Fig 3. Results of SAP modelling on new build units

* (total estimated array size calculated in section 4.3).

It can be seen from the table in Fig 3 that the worst case apartment will:

- Meet and exceed Building Regulations Part L1a minimum requirements.
- Achieve the LBRuT target for offsetting the predicted carbon emissions by 20% through the use of renewable energy technologies.
- Provide a sustainable development that targets a 'fabric first' approach to enable continued energy performance throughout the usable life of the building.

Proposed Case SAP Assessment roof layout:

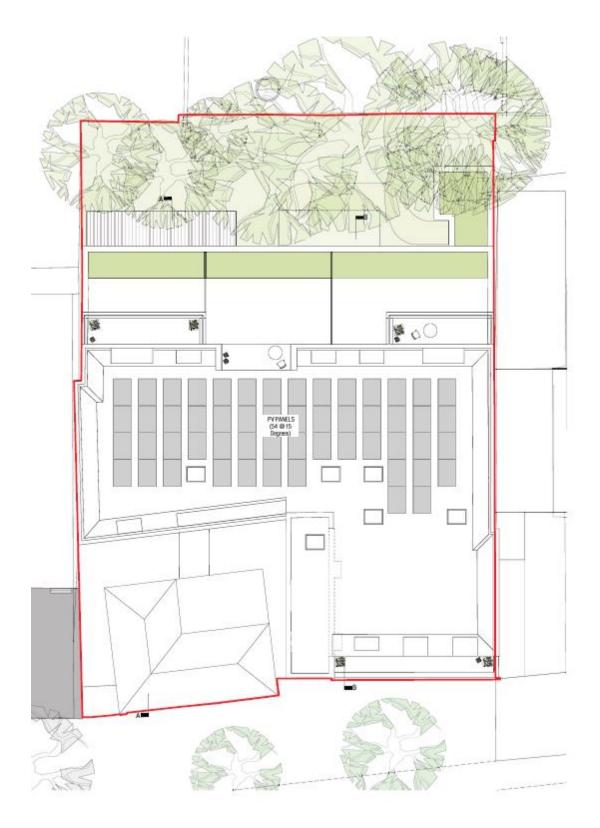


Fig 4. PV array location in relation to roof space

6.2 Cost of Options

A review of the most current information relating to the suitable option has been carried out to establish the likely costs of the complete system, and the sizing implications.

The cost for PV Panels has been based on quotations given by MCS installers and comparable developments.

The financial viability will need to be assessed against the financial incentives available and the overall development proposal.

Proposed Apartment Case – Gas Combi-Boiler with 1.05 kWp (3.2 No. 327Wp) Photovoltaic Panels

1.05kWp (3.2 x 333Wp) PV, which equals approx. 5.4m² of PV panels: £2,684. Gas Combi-boiler, supply & installation: £2,500.

Total estimated cost for Boiler & PVs: £5,184.

6.3 PV arrays

Required PV array for whole development (Proposed Case SAP Assessment)

Please note this estimated PV array calculation is based off of the worst case flat SAP assessment and therefore may be smaller as the other apartments are likely to be more energy efficient.

Renewable energy requirement: 1.05kWp per Unit

Total area of 10 No. Apartments: 598 m²

Energy requirement/m²: 0.0175 kWp/m²

Estimated PV array size for whole development to meet LBRuT 20% reduction in CO₂ emissions target:

Number of panels required -

Energy requirement / Peak Output (per panel) = 10.5kWp/0.333kWp = 32 Panels

Area of array - 1.6m² x 32 = 51.2 m²

Cost of array - $51.2m^2 \times \text{f}500/m^2 = \text{f}25,600$

Notes: Please note that the assumptions and feasibility of the proposed systems will have to be confirmed by an M&E Consultant and Structural Engineer, and that any changes will have an impact on the SAP results and therefore the achieved reduction in CO2 and % Renewables.

6.4 SAP CO₂ Emission Data

	Total kgCO₂/yr		
Unit	Base Case	Improved	Proposed Case
		Case	
Space Heating	839.63	360.45	365.57
Secondary Heating	N/A	N/A	N/A
Hot Water Heating	488.36	362.38	362.3
Fixed Electrical	38.93	38.93	38.93
Lighting	179.12	178.15	142.52
Cooking	163.0	163.0	163.0
Appliances	940.84	940.84	940.84
TOTAL	2649.89	2043.76	1598.74
% reduction overall ¹	n/a	22.87%	44.65%
Less amount of renewables	n/a	n/a	414.43
% reduction through renewables ²	n/a	n/a	20.59%
DER/TER variance	48.06%	-0.15%	-43.66%

Fig5. Table showing CO $_{\rm 2}$ output from SAP calculations.

7.0 BREEAM Domestic Refurbishment Pre Assessment

The development includes three residential units to be refurbished and as such a BREEAM Domestic Refurbishment Assessment has been carried out. Unit 4, as shown on the plans, has been deemed to be the "worst case" flat in relation to orientation, largest exposed wall and roof area and has therefore been the subject of the assessment.

As has been discussed in the BREEAM report compiled for the commercial units the nature of the site means that there is little scope for offsetting the ecological impact of the development, consequently the BREEAM Domestic Refurbishment assessment has targeted all other areas in order to achieve a rating of "excellent" as required by LBRuT policy.

7.1 Pre Assessment and Assumptions

The pre-assessment estimates how an "Excellent" rating can be achieved.

UNIT 7

BREEAM Refurbishment Rating: "Excellent"

Predicted Score: 78.74%

See Appendix B for the completed Pre-Assessment and the assumptions made.

	Existing Case1	Enhanced	Improved Case2
TOTAL kgCO2/yr	4783	1290	871
Reduction in Kg CO2/yr	n/a	3493	3912
% reduction in Kg CO2/yr	n/a	73%	81%
% reduction in Kg CO2/yr through renewables	n/a	n/a	32%
EPC rating	E	С	В

Fig6. Table of CO₂ emission improvement in refurbished dwelling

It can be seen from Fig 6 that the SAP rating is significantly improved as a result of the fabric upgrade with an additional enhancement coming from the addition of renewable technology. The flat will benefit from electricity produced by the PVs on the main roof. The costing for the efficient and renewable technologies included in the refurbishment will be the same as those of the new build documented in section 4.4

8.0 Discussion & Conclusion

This report documents the sustainability status of the proposed residential development at 179-181 High Street Hampton Hill, a further report from Metropolis Green deals with the commercial units.

Both the new and refurbished dwellings meet the requirements set out LBRuT's Core Strategy along with The London Plan, with regards to sustainability. The new build apartments have been tested against the Government Standard Assessment Procedure (SAP) 2012 achieving a worse case rating of 83. This rating is achieved through a fabric first approach to construction which has been augmented through the use of renewable technologies as required by the LBRuT policy. The refurbished units have achieved a similarly low SAP rating of 86 through fabric enhancements and the addition of renewable technology, resulting in an overall BREEAM rating of "Excellent".

The commercial report, carried out by Metropolis Green, discusses the difficulty and potential expense of achieving an excellent rating for the retail unit and it is suggested within that report that consideration should be given to lowering the requirement for the retail unit to one of "very good". The excellent rating achieved by the residential units should not be seen to undermine this recommendation as the residential assessment criteria carry different weightings.

A number of renewable technologies were evaluated for the project with consideration given to The Mayors Energy Strategy proposal 13 and it has been concluded that PV panels are the most suitable solution for this project. PVs offer the most efficient contribution to the reduction of CO2 on the site when considered with other design outcomes such as a low heating requirement for the building, as well as site restraints and location factors.

Appendices

Appendix A - SAP Worksheet – Proposed Apartment Option

LBRUT Sustainable Construction Checklist - January 2016

This document forms part of the Sustainable Construction Checklist SPD. This document **must** be filled out as part of the planning application for the following developments: all residential development providing **one or more new residential units (including conversions leading to one or more new units)**, and all other forms of development providing **100sqm or more of non-residential floor space**. Developments including new non-residential development of less than 100sqm floor space, extensions less than 100sqm, and other conversions are strongly encouraged to comply with this checklist. Where further information is requested, please either fill in the relevant section, or refer to the document where this information may be found in detail, e.g. Flood Risk Assessment or similar. **Further guidance** on completing the Checklist may be found in the Justification and Guidance section of this SPD.

Property Name (if relevant):	179 - 181 High Street Hampton Hill		Application No. (if known):	
Address (include. postcode) Completed by:	179 - 181 High Street Hampton Hill, Hampton, Andrew Alford	TW12 1NL		
For Non-Residential Size of development (m2)	540		For Residential Number of dwellings 10	
1 MINIMUM COMPLIAN	CE (RESIDENTIAL AND NON-RESIDENTIAL)			
	nent been submitted that demonstrates the expensive sures, including the feasibility of CHP/CCHP and	6,	5 5, ,	\checkmark
	uction tide emissions reduction against a Building Regu ndon Plan Policy 5.2 (2015) require a 35% redu		ding Regulations 2013.	35%
Percentage of total site	CO2 emissions saved through renewable energy	gy installation?		20
1A MINIMUM POLICY CO	MPLIANCE (NON-RESIDENTIAL AND DOMES	TIC REFURBISHMENT)		
Environmental Rating of devel	opment:	ance Section of this SPD for the po	blicy requirements	
Non-Residential new-build (100s BREEAM Level		Select	Have you attached a pre-assessment to support this?	
Extensions and conversions for I		001001		
BREEAM Domestic Ref		llent	Have you attached a pre-assessment to support this?	1
Extensions and conversions for a BREEAM Level		ellent	Have you attached a pre-assessment to support this?	<u>√</u>
Score awarded for Envi	ronmental Rating:			Subtotal

BREEAM: Good = 0, Very Good = 4, Excellent = 8, Outstanding = 16

1B MINIMUM POLICY COMPLIANCE (RESIDENTIAL)

Water Usage

Internal water usage limited to 105 litres person per day. (Excluding an allowance 5 litres per person per day for external water consumption). Calculations using the water efficiency calculator for new dwellings have been submitted.

	[1	1	
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Subtotal	1

2.1 N	leed for Cooling	Score
a.	How does the development incorporate cooling measures? Tick all that apply:	
	Energy efficient design incorporating specific heat demand to less than or equal to 15 kWh/sqm	6
	Reduce heat entering a building through providing/improving insulation and living roofs and walls	✓ 2
	Reduce heat entering a building through shading	
	Exposed thermal mass and high ceilings	4
	Passive ventilation	
	Mechanical ventilation with heat recovery	<u> </u>
	Active cooling systems, i.e. Air Conditioning Unit	
2.2 H	eat Generation	
b.	How have the heating and cooling systems, with preference to the heating system hierarchy, been selected (defined in London Plan policy 5.6)? Tick all heating and cooling systems that will be used in the development:	
	Connection to existing heating or cooling networks powered by renewable energy	<u> </u>
	Connection to existing heating or cooling networks powered by gas or electricity	
	Site wide CHP network network by renewable energy	

		Subtotal 6
e.	Have you attached a Lighting Pollution Report?	-
d.	Has the development taken measures to reduce light pollution impacts on character, residential amenity and biodiversity?	3
С.	Please tick only one option below Has the development taken measures to reduce existing noise and enhance the existing soundscape of the site? Has the development taken care to not create any new noise generation/transmission issues in its intended operation?	□ 3 ☑ 1
	information. If the proposed boiler is of a qualifying size, you may need to completed the information request form found on the Richmond website.	-
b.	Does the development plan include a biomass boiler? If yes, please refer to the biomass guidelines for the Borough of Richmond, please see guidance for supplementary	-
2.3 Po a.	Ilution: Air, Noise and Light Does the development plan to implement reduction strategies for dust emissions from construction sites?	✓ 2
	Site wide CHP network powered by renewable energy Site wide CHP network powered by gas Communal heating and cooling powered by renewable energy Communal heating and cooling powered by gas or electricity Individual heating and cooling	□ 5 □ 4 □ 3 □ 2 □ 1 ☑ 0

Please give any additional relevant comments to the Energy Use and Pollution Section below

2.1a As these are existing buildings, BTMs there are significant restrictions regarding the design of cooling systems/measures for these properties.2.2b There are no suitable existing or communal heating/cooling networks within close proximity.

3. TRANSPORT

3.1 Provision for the safe efficient and sustainable movement of people and goods

a. Does your development provide opportunities for occupants to use innovative travel technologies?

Please explain:

b.	Does your development include charging point(s) for electric cars?	2
С.	For major developments ONLY: Has a Transport Assessment been produced for your development based on TfL's Best Practice Guidance? If you have provided a Transport Assessment as part of your planning application, please tick here and move to Section 3 of this Checklist.	5
d.	For smaller developments ONLY: Have you provided a Transport Statement?	✓ 5
e.	Does your development provide cycle storage? (Standard space requirements are set out in the the Council's Parking Standards - DM DPD Appendix 4) If so, for how many bicycles? Is this shown on the site plans?	✓ 2 ✓ -
f.	Will the development create or improve links with local and wider transport networks? If yes, please provide details.	□ <i>2</i>
Please	e give any additional relevant comments to the Transport Section below	Subtotal
Please	see Sustainability Strategy and Transport Statement.	

7

a.	nimising the threat to biodiversity from new buildings, lighting, hard surfacing and people			— -
1.	Does your development involve the loss of an ecological feature or habitat, including a loss of g	arden or other green	space? (Indicate if yes)	√ -2
	If so, please state how much in sqm?			319 sq
) .	Does your development involve the removal of any tree(s)? (Indicate if yes)			- 🗸
	If so, has a tree report been provided in support of your application? (Ir	ndicate if yes)		-√
) .	Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes)			-
ł.	Please indicate which features and/or habitats that your development will incorporate to improve	e on site biodiversity:		
	Pond, reedbed or extensive native planting	6 🗌	Area provided:	so
	An extensive green roof	5 🗸	Area provided:	45 sc
	An intensive green roof	4	Area provided:	so
	Garden space	4 🗸	Area provided:	134 so
	Additional native and/or wildlife friendly planting to peripheral areas	3 🗸	Area provided:	30 so
	Additional planting to peripheral areas	2 🗸	Area provided:	so
	A living wall	2	Area provided:	so
	Bat boxes	0.5 🗸	, iou providou.	
	Bird boxes	0.5		
	Other	0.5		
	onal tree planting along High Street to continue existing 'avenue'			
	onal tree planting along High Street to continue existing 'avenue'			
	FLOODING AND DRAINAGE			
5	FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough			
litiga	FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes)			2
litiga	FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough			2
litiga	FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes)	< all that apply)		-
Mitiga 1.	FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes)	< all that apply)		□ - ✓ 5
Mitiga 1.	FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick			□ - ✓ 5 ✓ 3
5	FLOODING AND DRAINAGE Iting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use			5 3 4
Mitiga 1.	FLOODING AND DRAINAGE Iting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo			☐ - ✓ 5 ✓ 3 ☐ 4 ☐ 3
Mitiga 1.	FLOODING AND DRAINAGE Iting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo Attenuate rainwater in ponds or open water features			☐ -
litiga	FLOODING AND DRAINAGE Iting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo Attenuate rainwater in ponds or open water features Store rainwater in tanks for gradual release to a watercourse			☐ -
Mitiga 1.	FLOODING AND DRAINAGE Iting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo Attenuate rainwater in ponds or open water features Store rainwater in tanks for gradual release to a watercourse Discharge rainwater directly to watercourse			☐ -

Please provide details of the permeable surfacing below

please represent a loss in permeable area as a negative number

lease	give any additional relevant comments to the Flooding and Drainage Section below	Subtotal
	IMPROVING RESOURCE EFFICIENCY	
Re	uce waste generated and amount disposed of by landfill though increasing level of re-use and recycling Will demolition be required on your site prior to construction? [Points will only be awarded if 10% or greater of demolition waste is reused/recycled]	V 1
	If so, what percentage of demolition waste will be reused in the new development?	0 %
	What percentage of demolition waste will be recycled?	50 %
	Does your site have any contaminated land? Have you submitted an assessment of the site contamination?	□ 1 □ 2
	Are plans in place to remediate the contamination? Have you submitted a remediation plan? Are plans in place to include composting on site?	
Ro	Jucing levels of water waste	
	Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc Use of water efficient A or B rated appliances Rainwater harvesting for internal use Greywater systems Fit a water meter	✓ 1 ✓ 1 □ 4 □ 4 ✓ 1
	give any additional relevant comments to the Improving Resource Efficiency Section below	⊡ / Subtotal

Subtotal

7	ACCESSIBILITY									
7.1 a.	Ensure flexible adapt If the development is	residential, w	term use of structures If it meet the requirements of the nationally	described space standard for internal space and layout? provide details of the functionality of the internal space and layout	✓ 1					
AND o.	If the development is	residential, w	Il it meet Building Regulation Requirement	M4 (2) 'accessible and adaptable dwellings'? ails of any accessibility measures included in the development.	2					
			idential developments, are 10% or more of chair user dwellings'?	the units in the development to Building Regulation Requirement	1					
DR 5.	If the development is non-residential, does it comply with requirements included in Richmond's Design for Maximum Access SPG Please provide details of the accessibility measures specified in the Maximum Access SPG that will be included in the development									
معدما	nive any additional relev	ant comments	to the Design Standards and Accessibility S	Section below	Subtotal					
	3 ,									
	ustainable Construction	n Checklist- So	oring Matrix for New Construction	(Non-Residential and domestic refurb) TC	TAL 5					
01.50	Score	Rating	Significance							
01 30				rd in operav officient sustainable development						
01 30	80 or more	A+	Project strives to achieve highest standa	to in energy encient sustainable development						
01 30		A+ A	Makes a major contribution towards achi	eving sustainable development in Richmond						
	80 or more		Project strives to achieve highest standa Makes a major contribution towards achi Helps to significantly improve the Boroug	eving sustainable development in Richmond						
101 30	80 or more 71-79	A	Makes a major contribution towards achi	eving sustainable development in Richmond h's stock of sustainable developments						

Score	Rating	Significance
81 or more	A++	Project strives to achieve highest standard in energy efficient sustainable development
64-80	A+	Project strives to achieve highest standard in energy efficient sustainable development
55-63	Α	Makes a major contribution towards achieving sustainable development in Richmond
35-54	В	Helps to significantly improve the Borough's stock of sustainable developments
20-34	С	Minimal effort to increase sustainability beyond general compliance
19 or less	FAIL	Does not comply with SPD Policy

Authorisation:

I herewith declare that I have filled in this form to the best of my knowledge

Signature Andrew Alford

Date 01.06.2016

Appendix B – SAP Calculations

New Build	Base case
	Enhanced
	Enhanced with PV
Refurbishment	Existing
	Enhanced
	Enhanced with PV

Sap Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Andrew	Alford					As	sessor num	lber	1003		
Client							La	st modified		01/06	/2016	
Address	179-181 Hig	h Street,	Hampton	Hill, TW12	2 1NL							
			•									
1. Overall dwelling dimen	sions											
				A	irea (m²)			age storey ight (m)		Vo	olume (m³)	
Lowest occupied					52.00	<mark>(1a)</mark> x		2.40] (2a) =		124.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	52.00	(4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3	n) =	124.80	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								0] x 40 =		0	(6a)
Number of open flues								0] x 20 =		0	(6b)
Number of intermittent fan	S							2	x 10 =		20	(7a)
Number of passive vents								0	x 10 =		0	 (7b)
Number of flueless gas fires	5							0	x 40 =		0	(7c)
										Air	changes pe hour	r
Infiltration due to chimneys	s flues fans P	SVs		(6a)	+ (6b) + (7	a) + (7b) + (⁻	7c) =	20	÷ (5) =		0.16	(8)
If a pressurisation test has l			ntended p					-] . (3) =		0.10	
Air permeability value, q50,								- ()			10.00	(17)
If based on air permeability							urcu				0.66	(18)
Number of sides on which t					30 (10) (1	0)					2	(19)
Shelter factor		Shertere	4					1 -	[0.075 x (19		0.85	(20)
Infiltration rate incorporation	ng shelter fact	or						-	(18) x (2		0.56	(21)
Infiltration rate modified fo									(10) ^ (2	.0) =	0.50	(21)
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee			дрі	Ividy	Jun	Jui	Aug	Зер	000	NOV	Dec	
5.10		4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	5.00	4.90	4.40	4.30	5.80	5.80	3.70	4.00	4.30	4.50	4.70	_ (22)
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a				1	1	0.95	0.95	1.00	1.08	1.15	1.10	(22a)
	-	0.69	0.62	0.60	0.53	0.53	0.52	0.56	0.60	0.63	0.66	(22b)
Calculate effective air chang				0.00	0.55	0.55	0.52	0.50	0.00	0.05	0.00	_ (220)
If mechanical ventilation	-			n							N/A	(23a)
If balanced with heat rea	-				ctor from T	able 4h					N/A	(23c)
d) natural ventilation or	-	-	-							L	,,,	
0.76	· · · · ·	0.74	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.70	0.72	(24d)
Effective air change rate - e	I				0.04	0.04	0.05	0.00	0.00	5.70	0.72	_ (2+u)
0.76	· · ·	0.74	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.70	0.72	(25)
0.70	0.75	0.74	0.03	0.00	0.04	0.04	0.05	0.00	0.00	0.70	0.72	



3. Heat losses a	and heat lo	ss paramet	er										
Element			а	Gross rea, m ²	Openings m ²		area m²	U-value W/m²K	A x U V		value, I/m².K	Ахк, kJ/K	
Roof window						0.	.80 x	1.85	= 1.48	3			(27a)
Window						5.	.36 x	1.85	= 9.93	5			(27)
External wall						36	5.34 x	0.30	= 10.9	0			(29a)
Party wall						41	.10 x	0.00	= 0.00)			(32)
Roof						94	4.03 x	0.20	= 18.8	1			(30)
Total area of ext	ernal elem	ents ∑A, m²				13	6.53						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(2	(30) + ((32) =	41.12	(33)
Heat capacity Cr	n = ∑(А x к))						(28)	(30) + (32)	+ (32a)(3	2e) =	N/A	(34)
Thermal mass pa	arameter (1	ΓMP) in kJ/n	n²K									100.00	(35)
Thermal bridges	: Σ(L x Ψ) c	alculated us	sing Appen	dix K								20.48	(36)
Total fabric heat	loss									(33) + ((36) =	61.59	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	loss calcul	ated month	ly 0.33 x (2	25)m x (5)									
	31.14	30.73	30.32	28.44	28.09	26.45	26.45	26.14	27.08	28.09	28.80	29.55	(38)
Heat transfer co	efficient, V	V/K (37)m +	- (38)m										
	92.73	92.32	91.92	90.03	89.68	88.04	88.04	87.74	88.67	89.68	90.40	91.14	
									Average =	∑(39)112	/12 =	90.03	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)													
	1.78	1.78	1.77	1.73	1.72	1.69	1.69	1.69	1.71	1.72	1.74	1.75	
									Average =	∑(40)112	/12 =	1.73	(40)
Number of days	in month (Table 1a)											
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4 14/-4 1 1 ¹		· · · · · · · · · · · · · · · · · · ·							·				
4. Water heating		requiremen	τ			-							
Assumed occupa					(25 N)	26						1.75	(42)
Annual average		-						6	Com	0.4	Neu	75.74	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage		-	1					71.20	74.22	77.20	80.28	02.21	٦
	83.31	80.28	77.26	74.23	71.20	68.17	68.17	71.20	74.23	77.26		83.31	
Energy content (fhatwate	rucod = 4.1			2000 WWh/m	aanth (caa	Tablas 1b	1 o 1 d)		∑(44)1.	12 =	908.89	(44)
Energy content of	123.55	108.06	111.51	97.22	93.28	80.49		· ·	86.62	100.04	110.19	119.65	٦
	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	·		
Distribution loss	0 1E v (4E	Im								∑(45)1	12 =	1191.69	(45)
Distribution loss			16.73	14 59	12.00	12.07	11.19	12.84	12.99	15 14	16 52	17.95	
Water storage lo	18.53	16.21		14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95	(46)
water storage it		1			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
If the vessel cont	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
II the vessel com	0.00		-				1	1	0.00	0.00	0.00	0.00	
Drimony circuit la			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit lo	-	1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Combi loss for ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
				1	FOOC	40.22	F0.00	50.00	40.22	50.00	40.33	50.00	
Total heat requi	50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32 + (61)m	50.96	49.32	50.96	(61)
i otai neat requi		-		1						151.00	150 50	170.61	(62)
	174.51	154.09	162.47	146.53	144.24	129.81	125.55	136.55	135.93	151.90	159.50	170.61	(62)

Solar DHW input	t calculated	using App	endix G or A	Appendix H								
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)
Output from wa	ter heater f	or each mo	onth (kWh/i	month) (62	2)m + (63)n	n						
	174.51	154.09	162.47	146.53	144.24	129.81	125.55	136.55	135.93	151.90	159.50	170.61
										∑(64)1	12 = 1	1791.69 <mark>(64)</mark>
Heat gains from	water heat	ing (kWh/r	nonth) 0.2	5 × [0.85 ×	(45)m + (61	L)m] + 0.8 ×	[(46)m + (57)m + (59))m]			
	53.82	47.44	49.82	44.65	43.76	39.09	37.54	41.20	41.13	46.30	48.97	52.52 (65)
		·			•		•			•		
5. Internal gain	IS											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains	(Table 5)											
	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94 (66)
Lighting gains (ca	alculated in	Appendix	L, equation	L9 or L9a),	also see Ta	able 5						
	48.86	43.39	35.29	26.72	19.97	16.86	18.22	23.68	31.79	40.36	47.10	50.22 (67)
Appliance gains	(calculated	in Append	ix L, equatio	on L13 or L:	13a), also s	ee Table 5						
	227.50	229.86	223.91	211.25	195.26	180.24	170.20	167.84	173.79	186.45	202.44	217.46 (68)
Cooking gains (c	alculated in	Appendix	L, equation	L15 or L15	a), also see	e Table 5						
	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24 (69)
Pump and fan ga	ains (Table !	5a)										
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00 (70)
Losses e.g. evap	oration (Tal	ble 5)										
	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96 (71)
Water heating g	ains (Table	5)										
	72.34	70.59	66.96	62.02	58.81	54.30	50.46	55.38	57.12	62.23	68.01	70.60 (72)
Total internal ga	ins (66)m -	$(67)m \pm 10$	(60)	m + (70)m	+ (71)m + (72)m						
i otai internai ga	113 (00)11		56)III + (09)		• () ±), • (/2/11						
Total internal ga	433.92	429.07	411.39	385.21	359.27	336.62	324.10	332.12	347.92	374.27	402.77	423.50 (73)
_		1	1		1		324.10	332.12	347.92	374.27	402.77	423.50 (73)
6. Solar gains		1	411.39	385.21	359.27	336.62		332.12			402.77	······································
_		1	1	385.21	1	336.62 Sol	324.10 ar flux //m²	spec	g ific data	FF specific d	lata	423.50 (73) Gains W
_		1	411.39 Access f	385.21	359.27 Area	336.62 Sol	ar flux	spec	g	FF	lata	Gains
_		1	411.39 Access f	385.21 actor 6d	359.27 Area	336.62 Sol W	ar flux //m²	spec or T	g ific data	FF specific d or Table	lata	Gains
6. Solar gains		1	411.39 Access f Table	385.21 actor 6d	359.27 Area m²	336.62 Sol V	ar flux //m² 9.64 x	spec or T 0.9 x	g ific data able 6b	FF specific d or Table	lata 6c	Gains W
6. Solar gains	433.92	429.07	411.39 Access f Table	385.21 actor 6d	359.27 Area m ² 0.80	336.62 Sol V	ar flux //m² 9.64 x	spec or T 0.9 x	g ific data able 6b	FF specific d or Table 0.70	lata 6c	Gains W 7.13 (80)
6. Solar gains West West	433.92	429.07	411.39 Access f Table	385.21 actor 6d	359.27 Area m ² 0.80	336.62 Sol V	ar flux //m² 9.64 x	spec or T 0.9 x	g ific data able 6b	FF specific d or Table 0.70	lata 6c	Gains W 7.13 (80)
6. Solar gains West West	433.92 Atts Σ(74)m 32.91	429.07 (82)m 64.38	411.39 Access f Table 1.0 0.5 106.03	385.21 actor 6d 0 x [4 x [359.27 Area m ² 0.80 5.36	336.62 Sol X 1 X 1	ar flux //m ² 9.64 x 9.64 x	spec or T 0.9 x 0.9 x	g ific data able 6b 0.72 x 0.72 x	FF specific d or Table 0.70 0.70	lata 6c = =	Gains W 7.13 (80) 25.79 (80)
6. Solar gains West West Solar gains in wa	433.92 Atts Σ(74)m 32.91	429.07 (82)m 64.38	411.39 Access f Table 1.0 0.5 106.03	385.21 actor 6d 0 x [4 x [359.27 Area m ² 0.80 5.36	336.62 Sol X 1 X 1	ar flux //m ² 9.64 x 9.64 x	spec or T 0.9 x 0.9 x	g ific data able 6b 0.72 x 0.72 x	FF specific d or Table 0.70 0.70	lata 6c = =	Gains W 7.13 (80) 25.79 (80)
6. Solar gains West West Solar gains in wa Total gains - inte	433.92 atts ∑(74)m 32.91 ernal and so 466.84	429.07 (82)m 64.38 olar (73)m + 493.46	411.39 Access f Table 1.00 0.54 106.03 • (83)m 517.42	385.21 actor 6d 2 x (4 x (154.64	359.27 Area m ² 0.80 5.36 189.52	336.62 Sol M X 1 X 1 194.01	ar flux //m ² 9.64 x 9.64 x 184.70	spec or T 0.9 x 0.9 x 158.66	g ific data able 6b 0.72 x 0.72 x 123.32	FF specific d or Table 0.70 0.70 76.40	lata 6c = = 41.04	Gains W 7.13 (80) 25.79 (80) 27.07 (83)
 6. Solar gains West West Solar gains in wa Total gains - inter 7. Mean intern 	433.92 atts Σ(74)m 32.91 ernal and so 466.84 al tempera	429.07 429.07 64.38 Jar (73)m + 493.46 ture (heati	411.39 Access f Table 1.00 0.55 106.03 (83)m 517.42 ng season)	385.21 actor 6d 2 x (4 x (154.64 539.85	359.27 Area m ² 0.80 5.36 189.52 548.79	336.62 Sol M X 1 X 1 194.01 530.62	ar flux //m ² 9.64 x 9.64 x 184.70	spec or T 0.9 x 0.9 x 158.66	g ific data able 6b 0.72 x 0.72 x 123.32	FF specific d or Table 0.70 0.70 76.40	lata 6c = = 41.04	Gains W 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84)
6. Solar gains West West Solar gains in wa Total gains - inte	433.92 433.92 32.91 32.91 466.84 al temperation for the set of the	429.07 429.07 64.38 64.36 64.38 64.36 64.3	411.39 Access f Table 1.00 0.5- 106.03 (83)m 517.42 ng season) the living a	385.21 actor 6d 2 x (4 x (154.64 539.85 area from 1	359.27 Area m ² 0.80 5.36 189.52 548.79	336.62 Sol X 1 X 1 194.01 530.62	ar flux //m ² 9.64 x 9.64 x 9.64 x 184.70 508.80	spec or T 0.9 x 0.9 x 158.66 490.77	g ific data able 6b 0.72 x 0.72 x 123.32 471.24	FF specific d or Table 0.70 0.70 76.40 450.67	lata 6c] = [] = [41.04 443.81	Gains W 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85)
 6. Solar gains West West Solar gains in wa Total gains - inter 7. Mean intern Temperature du 	$\begin{array}{c} 433.92\\ \hline \\ 433.92\\ \hline \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	429.07 429.07 (82)m 64.38 dar (73)m + 493.46 ture (heati g periods in Feb	411.39 Access f Table 1.00 0.54 106.03 (83)m 517.42 ng season) the living a Mar	385.21 actor 6d 2 x (4 x (154.64 539.85 area from T Apr	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79	336.62 Sol M X 1 X 1 194.01 530.62	ar flux //m ² 9.64 x 9.64 x 184.70	spec or T 0.9 x 0.9 x 158.66	g ific data able 6b 0.72 x 0.72 x 123.32	FF specific d or Table 0.70 0.70 76.40	lata 6c = = 41.04	Gains W 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84)
 6. Solar gains West West Solar gains in wa Total gains - inter 7. Mean intern 	433.92 433.92 32.91 32.91 466.84 al temperation for gains f	429.07 429.07 64.38 64.38 64.38 1ar (73)m + 493.46 ture (heati g periods ir Feb or living ar	411.39 Access f Table 1.00 0.55 106.03 (83)m 517.42 ng season) the living a Mar ea n1,m (se	385.21 actor 6d x [4 x [154.64 539.85 area from T Apr e Table 9a)	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79	336.62 Sol X 1 X 1 194.01 530.62	ar flux //m ² 9.64 x 9.64 x 184.70 508.80	spec or T 0.9 x 0.9 x 158.66 490.77 Aug	g ific data able 6b 0.72 x 0.72 x 123.32 471.24 Sep	FF specific d or Table 0.70 0.70 76.40 450.67 Oct	lata 6c] = [] = [41.04 443.81	Gains W 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85) Dec
 6. Solar gains West West Solar gains in wat Total gains - intern 7. Mean intern Temperature du Utilisation factor 	433.92 atts $\Sigma(74)$ m 32.91 ernal and so 466.84 al tempera ring heating Jan r for gains f 0.94	429.07 429.07 64.38 dar (73)m + 493.46 ture (heati g periods in Feb or living are 0.93	411.39 Access f Table 1.00 0.54 (83)m 517.42 ng season) the living a Mar ea n1,m (se 0.91	385.21 actor 6d x [4 x [154.64 539.85 area from T Apr e Table 9a) 0.87	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79	336.62 Sol X 1 X 1 194.01 530.62	ar flux //m ² 9.64 x 9.64 x 9.64 x 184.70 508.80	spec or T 0.9 x 0.9 x 158.66 490.77	g ific data able 6b 0.72 x 0.72 x 123.32 471.24	FF specific d or Table 0.70 0.70 76.40 450.67	lata 6c] = [] = [41.04 443.81	Gains W 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85)
 6. Solar gains West West Solar gains in wa Total gains - inter 7. Mean intern Temperature du 	433.92 433.92 433.92 32.91 466.84 466.84 $al temperation for gains for ga$	429.07 429.07 64.38 74 74.46 74 74.46 74 74 74 74 74 74 74 74 74 74 74 74 74	411.39 Access f Table 1.00 0.54 106.03 (83)m 517.42 ng season) the living a Mar ea n1,m (se 0.91 steps 3 to 7	385.21 actor 6d 0 x 4 x 154.64 539.85 area from T Apr e Table 9a) 0.87 in Table 9c	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79 Table 9, Th1 May 0.80	336.62 Sol X 1 X 1 194.01 530.62 I(°C) Jun 0.70	ar flux //m ² 9.64 x 9.64 x 184.70 508.80 Jul 0.58	spec or T 0.9 x 0 0.9 x 0 158.66 490.77 Aug 0.61	g ific data able 6b 0.72 x 0.72 x 123.32 471.24 Sep 0.76	FF specific d or Table 0.70 0.70 76.40 450.67 0ct 0.87	lata 6c] = [] = [41.04 443.81 (Nov 0.92	Gains 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85) Dec 0.94 0.94 (86)
 6. Solar gains West West Solar gains in wat Total gains - intern 7. Mean intern Temperature du Utilisation factor Mean internal tern 	433.92 433.92 433.92 433.92 2(74)m 32.91 ernal and so 466.84 al tempera ring heating Jan r for gains f 0.94 emp of livin 17.87	429.07 429.07 64.38 74 64.38 74 74 74 74 74 74 74 74 74 74 74 74 74	411.39 Access f Table 1.00 0.5 106.03 (83)m 517.42 ng season) the living a Mar ea n1,m (se 0.91 steps 3 to 7 18.56	385.21 actor 6d x [4 x [4 x [154.64 539.85 area from 1 Apr e Table 9a) 0.87 in Table 9c	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79 548.79 548.79 0.80	336.62 Sol X 1 X 1 X 1 194.01 530.62 I(°C) Jun 0.70	ar flux //m ² 9.64 x 9.64 x 184.70 508.80	spec or T 0.9 x 0.9 x 158.66 490.77 Aug	g ific data able 6b 0.72 x 0.72 x 123.32 471.24 Sep	FF specific d or Table 0.70 0.70 76.40 450.67 Oct	lata 6c] = [] = [41.04 443.81	Gains W 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85) Dec
 6. Solar gains West West Solar gains in wat Total gains - intern 7. Mean intern Temperature du Utilisation factor 	433.92 atts $\Sigma(74)$ m 32.91 ernal and soc 466.84 al tempera ring heating Jan r for gains f 0.94 emp of livin 17.87 ring heating	429.07 429.07 (82)m 64.38 dar (73)m + 493.46 ture (heati g periods ir Feb or living are 0.93 g area T1 (s 18.10 g periods ir	411.39 Access f Table 1.00 0.54 106.03 (83)m 517.42 ng season) the living a Mar ea n1,m (se 0.91 steps 3 to 7 18.56 the rest of	385.21 actor 6d 2 x 4 x 154.64 539.85 area from 1 Apr e Table 9a) 0.87 in Table 9c 19.22 dwelling f	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79 548.79 0.80 0.80 19.87 rom Table 9	336.62 Sol X 1 X 1 194.01 530.62 L(°C) Jun 0.70 20.44 9, Th2(°C)	ar flux //m ² 9.64 x 9.64 x 184.70 508.80 Jul 0.58 20.73	spec or T 0.9 x 0 158.66 490.77 Aug 0.61 20.70	8 ific data able 6b 0.72 x 0.72 x 123.32 471.24 Sep 0.76	FF specific d or Table 0.70 0.70 76.40 450.67 0ct 0.87 19.45	lata 6c = [41.04 443.81 (Nov 0.92 18.58	Gains 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85) Dec 0.94 0.94 (86) 17.85 (87)
 6. Solar gains West West Solar gains in wat Total gains - intern 7. Mean intern Temperature du Utilisation factor Mean internal te Temperature du 	433.92 433.92 5(74)m 32.91 466.84 al tempera ring heating Jan r for gains f 0.94 emp of livin 17.87 ring heating 19.48	429.07 429.07 64.38 74 64.38 74 74 74 74 74 74 74 74 74 74 74 74 74	411.39 Access f Table 1.00 0.5 106.03 (83)m 517.42 ng season) the living a Mar ea n1,m (se 0.91 steps 3 to 7 18.56 n the rest of 19.49	385.21 actor 6d x [4 x [4 x [154.64 539.85 area from 1 Apr e Table 9a) 0.87 in Table 9a 19.22 f dwelling f 19.52	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79 548.79 548.79 0.80	336.62 Sol X 1 X 1 X 1 194.01 530.62 I(°C) Jun 0.70	ar flux //m ² 9.64 x 9.64 x 184.70 508.80 Jul 0.58	spec or T 0.9 x 0 0.9 x 0 158.66 490.77 Aug 0.61	g ific data able 6b 0.72 x 0.72 x 123.32 471.24 Sep 0.76	FF specific d or Table 0.70 0.70 76.40 450.67 0ct 0.87	lata 6c] = [] = [41.04 443.81 (Nov 0.92	Gains 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85) Dec 0.94 0.94 (86)
 6. Solar gains West West Solar gains in wat Total gains - intern 7. Mean intern Temperature du Utilisation factor Mean internal tern 	433.92 433.92 5(74)m 32.91 466.84 al tempera ring heating Jan r for gains f 0.94 emp of livin 17.87 ring heating 19.48	429.07 429.07 64.38 74 64.38 74 74 74 74 74 74 74 74 74 74 74 74 74	411.39 Access f Table 1.00 0.5 106.03 (83)m 517.42 ng season) the living a Mar ea n1,m (se 0.91 steps 3 to 7 18.56 n the rest of 19.49	385.21 actor 6d x [4 x [4 x [154.64 539.85 area from 1 Apr e Table 9a) 0.87 in Table 9a 19.22 f dwelling f 19.52	359.27 Area m ² 0.80 5.36 189.52 548.79 548.79 548.79 0.80 0.80 19.87 rom Table 9	336.62 Sol X 1 X 1 194.01 530.62 L(°C) Jun 0.70 20.44 9, Th2(°C)	ar flux //m ² 9.64 x 9.64 x 184.70 508.80 Jul 0.58 20.73	spec or T 0.9 x 0 158.66 490.77 Aug 0.61 20.70	8 ific data able 6b 0.72 x 0.72 x 123.32 471.24 Sep 0.76	FF specific d or Table 0.70 0.70 76.40 450.67 0ct 0.87 19.45	lata 6c = [41.04 443.81 (Nov 0.92 18.58	Gains 7.13 (80) 25.79 (80) 27.07 (83) 450.57 (84) 21.00 (85) Dec 0.94 0.94 (86) 17.85 (87)

Mean internal t	emperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	əc)						
	16.73	16.96	17.41	18.08	18.70	19.22	19.44	19.42	19.08	18.31	17.46	16.73	(90)
Living area fract	ion								Liv	ving area ÷	(4) =	0.52	(91)
Mean internal t	emperature	for the wh	ole dwellin	g fLA x T1 +	+(1 - fLA) x	Т2							
	17.32	17.55	18.01	18.67	19.31	19.85	20.11	20.08	19.69	18.91	18.04	17.31	(92)
Apply adjustme	nt to the me	ean interna	l temperati	ure from Ta	ble 4e whe	ere appropr	iate						_
	17.17	17.40	17.86	18.52	19.16	19.70	19.96	19.93	19.54	18.76	17.89	17.16	(93)
	-		•	•	•	•	•	•	·	•	•	·	-
8. Space heating	ng requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains, ı	յՠ	-							-		_	_
	0.90	0.89	0.86	0.82	0.74	0.62	0.49	0.51	0.68	0.82	0.88	0.91	(94)
Useful gains, ηn	nGm, W (94)m x (84)m	۱										_
	422.34	439.60	447.14	440.04	405.31	328.48	247.11	252.68	322.38	368.83	391.58	410.06	(95)
Monthly averag	e external to	emperatur	e from Tabl	e U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate fo	or mean inte	ernal tempe	erature, Lm	, W [(39)m	ı x [(93)m -	(96)m]							
	1193.86	1153.90	1043.95	866.39	668.72	449.28	296.17	310.13	482.81	731.45	975.47	1181.61	(97)
Space heating re	equirement,	kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)	m							
	574.01	480.01	444.03	306.97	195.97	0.00	0.00	0.00	0.00	269.79	420.40	574.04	
									∑(98	8)15, 10	.12 = 🔤	3265.22	(98)
Space heating re	equirement	kWh/m²/y	ear							(98)	÷ (4)	62.79	(99)
0		:	heating an			CLID		_					
9a. Energy req	unements -	mulviuuai	neating sys	stems mere		J-CHP							
Space heating	- I + (/									0.00	
Fraction of spac				ntary syste	m (table 1)	L)				1 - (20	21) -	0.00	(201)
Fraction of spac		-								1 - (20	JT) = [1.00	(202)
Fraction of spac		-							(20	2) [4. (20	2)]	0.00	(202)
Fraction of total									(20)2) x [1- (20		1.00	(204)
Fraction of total			system 2							(202) x (20	J3) = [0.00	(205)
Efficiency of ma	-								6	0.1		84.00	(206)
C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating for	-			265.44	222.20	0.00	0.00	0.00	0.00	224.40	500.40	600.00	1
	683.35	571.44	528.60	365.44	233.30	0.00	0.00	0.00	0.00	321.18	500.48	683.38	
									<u>Σ</u> (21)	1)15, 10	.12 =	3887.16	(211)
Water heating													
Efficiency of wa	r											1 -	.
	81.71	81.62	81.38	80.86	79.93	75.00	75.00	75.00	75.00	80.52	81.32	81.75	(217)
Water heating f	r		1			1				1			7
	213.56	188.79	199.63	181.21	180.45	173.08	167.40	182.07	181.24	188.65	196.15	208.70]
										∑(219a)1	.12 =	2260.92	(219)
Annual totals													7
Space heating for		stem 1										3887.16	
Water heating f												2260.92	
Electricity for pu								·		T			
central heati		water pun	np within w	arm air hea	ating unit				30.00]			(230c)
boiler flue fa									45.00]			(230e) ר
Total electricity	for the above	ve. kWh/ve	ar									75.00	(231)

Total delivered energy for all uses

(232)

6568.22	(238)
0000.22	(200)

345.13

10a. Fuel costs - individual heating systems including micro	o-CHP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3887.16	x	3.48	x 0.01 =	135.27	(240)
Water heating	2260.92	x	3.48	x 0.01 = [78.68	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	345.13	x	13.19	x 0.01 =	45.52	(250)
Additional standing charges				[120.00	(251)
Total energy cost			(240)(242) + (245)(254) = [389.37	(255)
11a. SAP rating - individual heating systems including micr	ro-CHP					
Energy cost deflator (Table 12)				[0.42	(256)
Energy cost factor (ECF)				[1.69	(257)
SAP value				[76.48	
SAP rating (section 13)				[76	(258)
SAP band				[С	
12a. CO ₂ emissions - individual heating systems including	micro-CHP					
	Energy		Emission factor		Emissions	
	kWh/year		kg CO₂/kWh		kg CO₂/year	
Space heating - main system 1	3887.16	x	kg CO₂/kWh	= [kg CO₂/year 839.63	(261)
Space heating - main system 1 Water heating	-	x x		= [= [) (261)) (264)
	3887.16		0.22	= [839.63	
Water heating	3887.16		0.22	= [839.63 488.36	(264)
Water heating Space and water heating	3887.16 2260.92	x	0.22 0.22 (261) + (262) + (= [263) + (264) = [839.63 488.36 1327.99] (264)] (265)
Water heating Space and water heating Pumps and fans	3887.16 2260.92 75.00	x x	0.22 0.22 (261) + (262) + (0.52 0.52	= [263) + (264) = [= [839.63 488.36 1327.99 38.93] (264)] (265)] (267)
Water heating Space and water heating Pumps and fans Electricity for lighting	3887.16 2260.92 75.00	x x	0.22 0.22 (261) + (262) + (0.52 0.52	= [263) + (264) = [= [= [839.63 488.36 1327.99 38.93 179.12	(264) (265) (267) (268)
Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year	3887.16 2260.92 75.00	x x	0.22 0.22 (261) + (262) + (0.52 0.52	= [263) + (264) = [= [265)(271) = [839.63 488.36 1327.99 38.93 179.12 1546.04	(264) (265) (267) (268) (268) (272)
Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate	3887.16 2260.92 75.00	x x	0.22 0.22 (261) + (262) + (0.52 0.52	= [263) + (264) = [= [265)(271) = [839.63 488.36 1327.99 38.93 179.12 1546.04 29.73	(264) (265) (267) (268) (268) (272)

Energy **Primary Energy Primary factor** kWh/year Space heating - main system 1 3887.16 1.22 х = Water heating 2260.92 1.22 х = Space and water heating (261) + (262) + (263) + (264) = 75.00 Pumps and fans 3.07 х = 345.13 3.07

Primary energy kWh/year	
-------------------------	--

Electricity for lighting

Dwelling primary energy rate kWh/m2/year

13a. Primary energy - individual heating systems including micro-CHP

kWh/year

4742.34

2758.32

7500.66

230.25

1059.56

8790.47

169.05

=

(261)

(264)

(265)

(267)

(268)

(272)

(273)

х

Sap Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Andrew Alfo	ord				As	sessor num	ber	1003		
Client						Las	st modified		26/05	/2016	
Address	179-181 High S	treet, Hampton	Hill, TW12	21							
		, 1									
1. Overall dwelling dimen	sions										
			Α	area (m²)			age storey ight (m)		Vo	lume (m³)	
Lowest occupied				52.00] <mark>(1a)</mark> x		2.40	(2a) =		124.80	(3a)
Total floor area	(1a) + (1b)	+ (1c) + (1d)(1n) =	52.00] (4)						
Dwelling volume						(3a)	+ (3b) + (3c	:) + (3d)(3	sn) =	124.80	(5)
2. Ventilation rate											
									m	³ per hour	
Number of chimneys							0	x 40 =		0	(6a)
Number of open flues							0	x 20 =		0	(6b)
Number of intermittent fan	S						2	x 10 =		20	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fires	5						0	x 40 =		0	(7c)
									Air o	changes pe hour	•
Infiltration due to chimneys	s flues fans PSVs		(6a)) + (6b) + (7a	a) + (7b) + (¹	7c) =	20	÷ (5) =	. [0.16	(8)
If a pressurisation test has l						·	-	. (3) -		0.10] (0)
Air permeability value, q50,										4.50	(17)
If based on air permeability										0.39	
Number of sides on which t					·						(18)
										2	(18)
Shelter factor	Ū						1 -	[0.075 x (19	9)] =	2	(18) (19) (20)
Shelter factor							1 -] (19)] (20)
	ng shelter factor						1 -	[0.075 x (19 (18) x (2		0.85	(19)
Shelter factor Infiltration rate incorporation	ng shelter factor	beed:	May	Jun	Jul	Aug	1 - Sep			0.85] (19)] (20)
Shelter factor Infiltration rate incorporatin Infiltration rate modified fo	ng shelter factor r monthly wind sp Feb Ma	beed:	Мау	Jun	Jul	Aug		(18) x (2	20) =	0.85] (19)] (20)
Shelter factor Infiltration rate incorporation Infiltration rate modified fo Jan	ng shelter factor r monthly wind sp Feb Ma	beed: ar Apr	May	Jun 3.80	Jul 3.80	Aug 3.70		(18) x (2	20) =	0.85] (19)] (20)
Shelter factor Infiltration rate incorporation Infiltration rate modified fo Jan Monthly average wind spee	ng shelter factor r monthly wind sp Feb Ma ed from Table U2	beed: ar Apr	·		1	-	Sep	(18) x (2 Oct	20) = Nov	0.85 0.33 Dec] (19)] (20)] (21)
Shelter factor Infiltration rate incorporatin Infiltration rate modified fo Jan Monthly average wind spee 5.10	ng shelter factor r monthly wind sp Feb Ma ed from Table U2	oeed: ar Apr 0 4.40	·		1	-	Sep	(18) x (2 Oct	20) = Nov	0.85 0.33 Dec] (19)] (20)] (21)
Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2	beed: Apr 0 4.40 3 1.10	4.30	0.95	3.80	3.70	Sep 4.00	(18) x (2 Oct 4.30	20) = Nov 4.50	0.85 0.33 Dec 4.70] (19)] (20)] (21)] (22)
Shelter factor Infiltration rate incorporatin Infiltration rate modified fo Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2	oeed: Apr 0 4.40 3 1.10 r and wind factor	4.30	0.95	3.80	3.70	Sep 4.00	(18) x (2 Oct 4.30	20) = Nov 4.50	0.85 0.33 Dec 4.70] (19)] (20)] (21)] (22)
Shelter factor Infiltration rate incorporatin Infiltration rate modified fo Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2 llowing for shelter 0.41 0.4	beed: Apr 0 4.40 3 1.10 r and wind factor 0 0.36	4.30 1.08 or) (21) x (2	3.80 0.95 22a)m	3.80 0.95	3.70 0.93	Sep 4.00 1.00	(18) x (2 Oct 4.30	20) = Nov 4.50 1.13	0.85 0.33 Dec 4.70] (19)] (20)] (21)] (22)] (22a)
Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.42	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2 Ilowing for shelter 0.41 0.4 ge rate for the ap	beed: Apr 0 4.40 3 1.10 r and wind factor 0 0.36 blicable case:	4.30 1.08 or) (21) x (2 0.35	3.80 0.95 22a)m	3.80 0.95	3.70 0.93	Sep 4.00 1.00	(18) x (2 Oct 4.30	20) = Nov 4.50 1.13	0.85 0.33 Dec 4.70] (19)] (20)] (21)] (22)] (22a)
Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind speed 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.42 Calculate effective air changed	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2 Ilowing for shelter 0.41 0.4 ge rate for the apple air change rate for	beed: Apr Apr 0 4.40 3 1.10 r and wind factor 0 0.36 blicable case: through system	4.30 1.08 or) (21) x (2 0.35	3.80 0.95 22a)m 0.31	3.80 0.95 0.31	3.70 0.93	Sep 4.00 1.00	(18) x (2 Oct 4.30	20) = Nov 4.50 1.13	0.85 0.33 Dec 4.70 1.18 0.38] (19)] (20)] (21)] (22)] (22a)] (22b)
Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.42 Calculate effective air change If mechanical ventilation	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2 Ilowing for shelter 0.41 0.4 ge rate for the apple air change rate covery: efficiency	beed: Apr Apr 0 4.40 3 1.10 r and wind factor 0 0.36 olicable case: through system in % allowing for	4.30 1.08 or) (21) x (2 0.35 n or in-use fa	3.80 0.95 22a)m 0.31	3.80 0.95 0.31	3.70 0.93	Sep 4.00 1.00	(18) x (2 Oct 4.30	20) = Nov 4.50 1.13	0.85 0.33 Dec 4.70 1.18 0.38] (19)] (20)] (21)] (22)] (22a)] (22b)] (22b)] (23a)
Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind speed 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.42 Calculate effective air change If mechanical ventilation If balanced with heat red	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2 Ilowing for shelter 0.41 0.4 ge rate for the apple air change rate covery: efficiency	beed: Apr Apr 0 4.40 3 1.10 r and wind factor 0 0.36 blicable case: through system in % allowing for itive input vent	4.30 1.08 or) (21) x (2 0.35 n or in-use fa	3.80 0.95 22a)m 0.31	3.80 0.95 0.31	3.70 0.93	Sep 4.00 1.00	(18) x (2 Oct 4.30	20) = Nov 4.50 1.13	0.85 0.33 Dec 4.70 1.18 0.38] (19)] (20)] (21)] (22)] (22a)] (22b)] (22b)] (23a)
Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind speed 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.42 Calculate effective air change If mechanical ventilation If balanced with heat read d) natural ventilation or	r monthly wind sp Feb Ma ed from Table U2 5.00 4.9 1.25 1.2 Ilowing for shelter 0.41 0.4 ge rate for the ap 1.21 change rate for the ap 1.22 covery: efficiency whole house post 0.58 0.5	beed: Apr Apr 0 4.40 3 1.10 r and wind factor 0 0.36 olicable case: through system in % allowing for itive input vent 8 0.56	4.30 1.08 or) (21) x (2 0.35 or in-use fa ilation from 0.56	3.80 0.95 22a)m 0.31	3.80 0.95 0.31 able 4h	3.70 0.93 0.30	Sep 4.00 1.00	(18) x (2 Oct 4.30 1.08 0.35	Nov 4.50 1.13 0.37	0.85 0.33 Dec 4.70 1.18 0.38 N/A N/A] (19)] (20)] (21)] (22)] (22a)] (22a)] (22b)] (23a)] (23c)



3. Heat losses a	and heat lo	ss paramet	er										
Element				Gross rea, m²	Openings m ²		area m²	U-value W/m²K	A x U W		/alue, /m².K	Ахк, kJ/K	
Roof window						0	.80 x	1.50	= 1.20				(27a)
Window						5	.36 x	1.26	= 6.77				(27)
External wall						36	5.34 x	0.22	= 7.99				(29a)
Party wall						41	10 x	0.00	= 0.00				(32)
Roof						53	.87 x	0.12	= 6.46				(30)
Roof						40).16 x	0.13	= 5.22				(30)
Total area of ext	ternal elem	ents ∑A, m²	1			13	6.53						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32) =	27.65	(33)
Heat capacity Cr	m = ∑(А x к)							(28)	.(30) + (32) -	+ (32a)(3	2e) =	N/A	(34)
Thermal mass pa	arameter (T	·MP) in kJ/n	n²K									100.00	(35)
Thermal bridges	s: Σ(L x Ψ) ca	alculated us	sing Appen	dix K								3.29	(36)
Total fabric heat	t loss									(33) + (36) =	30.94	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	loss calcula	ated month	ly 0.33 x (2	25)m x (5)									
	24.18	24.04	23.91	23.26	23.14	22.58	22.58	22.48	22.80	23.14	23.39	23.64	(38)
Heat transfer co	efficient, W	//K (37)m +	- (38)m									-	_
	55.12	54.98	54.84	54.20	54.08	53.52	53.52	53.42	53.74	54.08	54.33	54.58]
									Average = 2	<u>(</u> 39)112	/12 =	54.20	(39)
Heat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)										_
	1.06	1.06	1.05	1.04	1.04	1.03	1.03	1.03	1.03	1.04	1.04	1.05]
									Average = 2	<u>(</u> 40)112	/12 =	1.04	(40)
Number of days	in month (⁻	Table 1a)											_
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
						_							
4. Water heati		equiremen	t										
Assumed occupa												1.75	(42)
Annual average	hot water u	-	es per day '			36						75.74	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage					tor from Tab	le 1c x (43					i	i	_
	83.31	80.28	77.26	74.23	71.20	68.17	68.17	71.20	74.23	77.26	80.28	83.31	
										∑(44)1	.12 =	908.89	(44)
Energy content	of hot wate	r used = 4.1		nm x Tm/3	3600 kWh/m	onth (see	Tables 1b	, 1c 1d)				-	_
	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65	
										∑(45)1	.12 =	1191.69	(45)
Distribution loss	0.15 x (45)m											_
	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95	(46)
Water storage lo	oss calculate	ed for each	month (55	5) x (41)m				_	_			- -	_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel con	tains dedica	ated solar s	torage or d	edicated W	VWHRS (56)r	n x [(47) -	Vs] ÷ (47)	, else (56)					_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit lo	oss for each	month fro	m Table 3			_							_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for e	ach month	from Table	3a, 3b or 3	c									
	38.44	34.72	38.44	37.20	38.44	37.20	38.44	38.44	37.20	38.44	37.20	38.44	(61)
Total heat requi	red for wat	er heating o	calculated f	or each mo	onth 0.85 x (45)m + (4	6)m + (57))m + (59)m ·	+ (61)m				

	161.99	142.78	149.94	134.41	131.72	117.69	113.03	124.03	123.81	139.38	147.38	158.09	(62)
Solar DHW inpu						117.05	110.00	12 1.00	125.01	100.00	117.50	150.05] (02)
50.0. <u>2</u> pu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Flue gas heat re					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00] (03)
The gas near re-	-18.50	-16.38	-16.72	-13.91	-12.59	-10.11	-9.57	-10.69	-10.73	-14.14	-16.53	-18.13	(63)
Output from wa			I		II		-9.57	-10.09	-10.75	-14.14	-10.55	-10.15] (03)
							102.46	112.24	112.00	125.22	120.96	120.06	1
	143.49	126.40	133.22	120.50	119.13	107.58	103.46	113.34	113.08	125.23	130.86	476.25	
lloot going from	water beat	ing (WMb/m	n a n th) 0 25		(4E) m + (61	\ml + 0.8 v	[(46)m + (1	-7)m + (F0)		∑(64)1	.12 =	.476.25	(64)
Heat gains from						-							1 (0-1)
	50.69	44.61	46.69	41.62	40.62	36.06	34.41	38.07	38.10	43.17	45.94	49.39	(65)
5. Internal gair	ıs												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	(66)
Lighting gains (c	alculated in	Appendix I	L, equation	L9 or L9a),	also see Ta	ble 5							-
	48.59	43.16	35.10	26.57	19.86	16.77	18.12	23.55	31.61	40.14	46.85	49.94	(67)
Appliance gains	(calculated	in Appendi	ix L, equatio	on L13 or L1	L3a), also se	e Table 5							_ · ·
	227.50	229.86	223.91	211.25	195.26	180.24	170.20	167.84	173.79	186.45	202.44	217.46	(68)
Cooking gains (c											-] ()
00 (47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	(69)
Pump and fan ga] ()
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evap			5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00] (70)
Losses e.g. erup													
	-		60.06	60.06	60.06	60.06	60.06	60.06	60.06	60.06	60.06	60.06	(71)
Water heating g	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96] (71)
Water heating g	-69.96 ains (Table	-69.96 5)									1	1	
	-69.96 ains (Table 68.13	-69.96 5) 66.38	62.75	57.81	54.60	50.09	-69.96 46.25	-69.96 51.17	-69.96 52.91	-69.96 58.03	-69.96 63.80	-69.96 66.39] (71)] (72)
Water heating g Total internal ga	-69.96 ains (Table 68.13 ains (66)m +	-69.96 5) 66.38 + (67)m + (6	62.75 58)m + (69)r	57.81 n + (70)m -	54.60 + (71)m + (7	50.09 72)m	46.25	51.17	52.91	58.03	63.80	66.39] (72)
	-69.96 ains (Table 68.13	-69.96 5) 66.38	62.75	57.81	54.60	50.09					1	1	
	-69.96 ains (Table 68.13 ains (66)m +	-69.96 5) 66.38 + (67)m + (6	62.75 58)m + (69)r	57.81 n + (70)m -	54.60 + (71)m + (7	50.09 72)m	46.25	51.17	52.91	58.03	63.80	66.39] (72)
Total internal ga	-69.96 ains (Table 68.13 ains (66)m +	-69.96 5) 66.38 + (67)m + (6	62.75 58)m + (69)r 406.99 Access f	57.81 n + (70)m - 380.86 actor	54.60 + (71)m + (7 354.95 Area	50.09 (2)m 332.32 Sola	46.25 319.79 ar flux	51.17 327.78	52.91 343.54 g	58.03 369.84 FF	63.80 398.31	66.39] (72)
Total internal ga	-69.96 ains (Table 68.13 ains (66)m +	-69.96 5) 66.38 + (67)m + (6	62.75 58)m + (69)r 406.99	57.81 n + (70)m - 380.86 actor	54.60 + (71)m + (7 354.95	50.09 (2)m 332.32 Sola	46.25 319.79	51.17 327.78 speci	52.91 343.54 g fic data	58.03 369.84 FF specific c	63.80 398.31	66.39 419.02] (72)
Total internal ga	-69.96 ains (Table 68.13 ains (66)m +	-69.96 5) 66.38 + (67)m + (6	62.75 58)m + (69)r 406.99 Access f Table	57.81 n + (70)m - 380.86 actor 6d	54.60 + (71)m + (7 354.95 Area m ²	50.09 72)m 332.32 Sola W	46.25 319.79 ar flux //m ²	51.17 327.78 speci or Ta	52.91 343.54 g fic data able 6b	58.03 369.84 FF specific c or Table	63.80 398.31 lata	66.39 419.02 Gains W] (72)] (73)
Total internal ga	-69.96 ains (Table 68.13 ains (66)m +	-69.96 5) 66.38 + (67)m + (6	62.75 58)m + (69)r 406.99 Access f Table	57.81 n + (70)m - 380.86 actor 6d	54.60 + (71)m + (7 354.95 Area m ² 0.80	50.09 72)m 332.32 Sola V X 1	46.25 319.79 ar flux //m ² 9.64 x	51.17 327.78 speci or Ta 0.9 x 0	52.91 343.54 g fic data able 6b 0.72 x	58.03 369.84 FF specific c or Table	63.80 398.31	66.39 419.02 Gains W 8.15] (72)] (73)] (80)
Total internal ga 6. Solar gains West West	-69.96 ains (Table 1 68.13 ains (66)m + 429.45	-69.96 5) 66.38 + (67)m + (6 424.63	62.75 58)m + (69)r 406.99 Access f Table	57.81 n + (70)m - 380.86 actor 6d	54.60 + (71)m + (7 354.95 Area m ²	50.09 72)m 332.32 Sola V X 1	46.25 319.79 ar flux //m ² 9.64 x	51.17 327.78 speci or Ta 0.9 x 0	52.91 343.54 g fic data able 6b	58.03 369.84 FF specific c or Table	63.80 398.31 lata	66.39 419.02 Gains W] (72)] (73)
Total internal ga 6. Solar gains West	-69.96 ains (Table 1 68.13 ains (66)m + 429.45	-69.96 5) 66.38 + (67)m + (6 424.63	62.75 58)m + (69)r 406.99 Access f Table	57.81 n + (70)m - 380.86 actor 6d	54.60 + (71)m + (7 354.95 Area m ² 0.80	50.09 72)m 332.32 Sola V X 1	46.25 319.79 ar flux //m ² 9.64 x	51.17 327.78 speci or Ta 0.9 x 0	52.91 343.54 g fic data able 6b 0.72 x	58.03 369.84 FF specific c or Table	63.80 398.31 data 6c	66.39 419.02 Gains W 8.15] (72)] (73)] (80)
Total internal ga 6. Solar gains West West	-69.96 ains (Table 1 68.13 ains (66)m + 429.45	-69.96 5) 66.38 + (67)m + (6 424.63	62.75 58)m + (69)r 406.99 Access f Table	57.81 n + (70)m - 380.86 actor 6d	54.60 + (71)m + (7 354.95 Area m ² 0.80	50.09 72)m 332.32 Sola V X 1	46.25 319.79 ar flux //m ² 9.64 x	51.17 327.78 speci or Ta 0.9 x 0	52.91 343.54 g fic data able 6b 0.72 x	58.03 369.84 FF specific c or Table	63.80 398.31 data 6c	66.39 419.02 Gains W 8.15] (72)] (73)] (80)
Total internal ga 6. Solar gains West West	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 atts $\Sigma(74)$ m 33.93	-69.96 5) 66.38 + (67)m + (6 424.63	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54	57.81 n + (70)m - 380.86 actor 6d	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36	50.09 72)m 332.32 Sola V 2 x 1 x 1	46.25 319.79 ar flux //m ² 9.64 x 9.64 x	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0	52.91 343.54 fic data able 6b 0.72 x 0.72 x	58.03 369.84 FF specific c or Table 0.80 0.70	63.80 398.31 data 6c = =	66.39 419.02 Gains W 8.15 25.79] (72)] (73)] (80)] (80)
Total internal ga 6. Solar gains West West Solar gains in wa	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 atts $\Sigma(74)$ m 33.93	-69.96 5) 66.38 + (67)m + (6 424.63	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54	57.81 n + (70)m - 380.86 actor 6d	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36	50.09 72)m 332.32 Sola V 2 x 1 x 1	46.25 319.79 ar flux //m ² 9.64 x 9.64 x	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0	52.91 343.54 fic data able 6b 0.72 x 0.72 x	58.03 369.84 FF specific c or Table 0.80 0.70	63.80 398.31 data 6c = =	66.39 419.02 Gains W 8.15 25.79] (72)] (73)] (80)] (80)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - inte	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 atts $\Sigma(74)m$ 33.93 ernal and so 463.38	-69.96 5) 66.38 + (67)m + (6 424.63 424.63	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 · (83)m 516.30	57.81 n + (70)m - 380.86 actor 6d 2 x [4 x [159.42	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38	50.09 72)m 332.32 Sol: W 200.01	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 190.42	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13	58.03 369.84 FF specific c or Table 0.80 0.70 78.76	63.80 398.31 data 6c = = 42.31	66.39 419.02 Gains W 8.15 25.79 27.90] (72)] (72)] (73)] (80)] (80)] (80)] (83)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - international 7. Mean internation	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 429.45 atts $\Sigma(74)m$ 33.93 ernal and so 463.38 hal temperation	-69.96 5) 66.38 + (67)m + (6 424.63 424.63 (424.63 (424.63) (424.6	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 · (83)m 516.30 ng season)	57.81 n + (70)m - 380.86 actor 6d 0 x [4 x [159.42 540.28	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38 195.38	50.09 72)m 332.32 Sola W 200.01 532.33	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 190.42	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13	58.03 369.84 FF specific c or Table 0.80 0.70 78.76	63.80 398.31 data 6c = [42.31 440.62	66.39 419.02 Gains W 8.15 25.79 27.90 446.92] (72)] (72)] (73)] (80)] (80)] (80)] (83)] (84)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - inte	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 429.45 atts $\Sigma(74)m$ 33.93 ernal and so 463.38 hal temperation	-69.96 5) 66.38 + (67)m + (6 424.63 424.63 (424.63 (424.63) (424.6	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 · (83)m 516.30 ng season)	57.81 n + (70)m - 380.86 actor 6d 2 x [4 x [159.42 540.28 area from T	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38 550.33	50.09 72)m 332.32 Sola W X 1 X 1 200.01 532.33 (°C)	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 9.64 x 190.42 510.21	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56 491.35	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13 470.67	58.03 369.84 FF specific c or Table 0.80 0.70 78.76 448.60	63.80 398.31 data 6c = [42.31 440.62	66.39 419.02 Gains W 8.15 25.79 27.90 446.92 21.00] (72)] (72)] (73)] (80)] (80)] (80)] (83)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern Temperature du	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 429.45 atts $\Sigma(74)m$ 33.93 ernal and so 463.38 hal temperation Jan	-69.96 5) 66.38 + (67)m + (6 424.63 424.63 424.63 (82)m 66.38 lar (73)m + 491.00 ture (heating g periods in Feb	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 · (83)m 516.30 ng season) n the living a Mar	57.81 n + (70)m - 380.86 actor 6d 0 x [4 x [159.42 540.28 area from T Apr	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38 195.38 550.33	50.09 72)m 332.32 Sola W 200.01 532.33	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 190.42	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13	58.03 369.84 FF specific c or Table 0.80 0.70 78.76	63.80 398.31 data 6c = = 42.31 440.62	66.39 419.02 Gains W 8.15 25.79 27.90 446.92] (72)] (72)] (73)] (80)] (80)] (80)] (83)] (84)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - international 7. Mean internation	$\begin{array}{c} -69.96 \\ \hline \\ ains (Table 1) \\ \hline \\ 68.13 \\ \hline \\ ains (66)m + \\ \hline \\ 429.45 \\ \hline \\ 429.45 \\ \hline \\ 33.93 \\ \hline \\ arnal and so \\ \hline \\ 463.38 \\ \hline \\ and temperative \\ Jan \\ r for gains for for for gains for for for gains for for for gains for for for for for gains for for for for for for gains for for for for for for for for for for$	-69.96 5) 66.38 (67)m + (6 424.63 (424.63	62.75 68)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 (83)m 516.30 ng season) n the living a Mar ea n1,m (sec	57.81 n + (70)m - 380.86 actor 6d 0 x [4 x [159.42 540.28 area from T Apr e Table 9a)	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38 550.33 550.33	50.09 72)m 332.32 Sola V 200.01 532.33 (°C) Jun	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 9.64 x 190.42 510.21	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56 491.35 Aug	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13 470.67 Sep	58.03 369.84 FF specific c or Table 0.80 0.70 78.76 448.60	63.80 398.31 data 6c = [] = [42.31 440.62 Nov	66.39 419.02 Gains W 8.15 25.79 27.90 446.92 21.00 Dec] (72)] (72)] (73)] (80)] (80)] (80)] (83)] (83)] (84)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern Temperature du Utilisation facto	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 429.45 33.93 ernal and so 463.38 hal temperations using heating Jan r for gains for 0.92	-69.96 5) 66.38 (67)m + (6 424.63 424.63 (62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 · (83)m 516.30 ng season) n the living a Mar ea n1,m (sea 0.87	57.81 n + (70)m - 380.86 actor 6d 0 x [4 x [159.42 540.28 area from T Apr e Table 9a) 0.80	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38 195.38 550.33	50.09 72)m 332.32 Sola W X 1 X 1 200.01 532.33 (°C)	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 9.64 x 190.42 510.21	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56 491.35	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13 470.67	58.03 369.84 FF specific c or Table 0.80 0.70 78.76 448.60	63.80 398.31 data 6c = [42.31 440.62	66.39 419.02 Gains W 8.15 25.79 27.90 446.92 21.00] (72)] (72)] (73)] (80)] (80)] (80)] (83)] (84)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern Temperature du	$\begin{array}{c} -69.96 \\ \hline \\ ains (Table 1) \\ \hline \\ 68.13 \\ \hline \\ ains (66)m + \\ \hline \\ 429.45 \\ \hline \\ 429.45 \\ \hline \\ atts \sum (74)m \\ \hline \\ 33.93 \\ \hline \\ arnal and so \\ \hline \\ 463.38 \\ \hline \\ and temperation for gains for gains$	-69.96 5) 66.38 (67)m + (6 424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63 (424.63) (42	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 (83)m 516.30 ng season) n the living a Mar ea n1,m (see 0.87 steps 3 to 7	57.81 n + (70)m - 380.86 actor 6d x [159.42 540.28 area from T Apr e Table 9a) 0.80 in Table 9c	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38 550.33 550.33 able 9, Th1 May 0.70	50.09 72)m 332.32 Sola W 200.01 532.33 (°C) Jun 0.56	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 190.42 510.21 Jul 0.43	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56 491.35 Aug 0.46	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13 470.67 Sep 0.64	58.03 369.84 FF specific c or Table 0.80 0.70 78.76 448.60	63.80 398.31 data 6c = [42.31 440.62 Nov 0.89	66.39 419.02 Gains W 8.15 25.79 27.90 27.90 446.92 21.00 Dec 0.92] (72)] (72)] (73)] (80)] (80)] (80)] (83)] (83)] (84)] (85)] (86)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern Temperature du Utilisation facto	-69.96 ains (Table 1 68.13 ains (66)m + 429.45 429.45 atts $\Sigma(74)m$ 33.93 ernal and so 463.38 al temperation tring heating Jan r for gains for 0.92 emp of living 19.24	-69.96 5) 66.38 + (67)m + (6 424.63 424.63 (424.63	62.75 58)m + (69)r 406.99 Access f Table 1.00 0.54 109.31 · (83)m 516.30 ng season) n the living a Mar ea n1,m (see 0.87 steps 3 to 7 19.77	57.81 n + (70)m - 380.86 actor 6d 0 x 4 x 159.42 540.28 area from T Apr e Table 9a) 0.80 in Table 9c 20.21	54.60 + (71)m + (7 354.95 Area m ² 0.80 5.36 195.38 195.38 550.33 able 9, Th1 May 0.70 :) 20.58	50.09 '2)m 332.32 Sola W 200.01 200.01 532.33 (°C) Jun 0.56 20.84	46.25 319.79 ar flux //m ² 9.64 x 9.64 x 9.64 x 190.42 510.21	51.17 327.78 speci or Ta 0.9 x 0 0.9 x 0 163.56 491.35 Aug	52.91 343.54 g fic data able 6b 0.72 x 0.72 x 127.13 470.67 Sep	58.03 369.84 FF specific c or Table 0.80 0.70 78.76 448.60	63.80 398.31 data 6c = [] = [42.31 440.62 Nov	66.39 419.02 Gains W 8.15 25.79 27.90 446.92 21.00 Dec] (72)] (72)] (73)] (80)] (80)] (80)] (83)] (83)] (84)

	20.03	20.04	20.04	20.05	20.05	20.06	20.06	20.06	20.06	20.05	20.05	20.04	(88)
Utilisation facto] ()
	0.91	0.89	0.85	0.77	0.66	0.50	0.35	0.38	0.58	0.78	0.88	0.91	(89)
Mean internal te	emperature	in the rest	of dwelling		steps 3 to			1	1	1	1], ,
	18.45	18.63	18.96	19.39	19.73	19.96	20.03	20.03	19.89	19.48	18.92	18.42	(90)
Living area fract	ion			I	1	1			Li	ving area ÷	(4) =	0.52	(91)
Mean internal te		for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x T	Г2				-			
	18.86	19.04	19.38	19.81	20.17	20.42	20.51	20.50	20.34	19.90	19.33	18.83	(92)
Apply adjustme	nt to the me	ean internal	temperati	ure from Ta	ble 4e whe	re appropr	iate	•			•	•	-
	18.71	18.89	19.23	19.66	20.02	20.27	20.36	20.35	20.19	19.75	19.18	18.68	(93)
0 Correction	· · · · ·												
8. Space heatir			Mar	A	Max	1	11	Aug	For	Oct	Nev	Dec	
Utilication facto	Jan	Feb	war	Apr	May	Jun	Jul	Aug	Sep	Οcι	Nov	Dec	
Utilisation facto	-		0.02	0.70	0.00	0.51	0.20	0.41	0.50	0.77	0.00	0.00	
Useful gains, ηm	0.89	0.87	0.83	0.76	0.66	0.51	0.38	0.41	0.59	0.77	0.86	0.90	94)
Oserui gairis, ijri	412.74	427.63	429.92	412.07	262.10	272.75	101.92	100.15	278.08	245.62	270.00	401.43	
Monthly average				412.07	362.10	272.75	191.82	199.15	278.98	345.63	378.89	401.43	(95)
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate fo							10.00	10.40	14.10	10.60	7.10	4.20] (90)
	794.44	769.45	698.02	583.29	450.19	303.42	201.08	210.86	327.35	494.87	656.14	790.24	(97)
Space heating re							201.08	210.80	327.33	494.87	050.14	790.24] (57)
Space nearing re	283.98	229.70	199.47	123.28	65.54	0.00	0.00	0.00	0.00	111.03	199.61	289.27	1
	205.50	229.70	199.47	125.20	05.54	0.00	0.00	0.00		8)15, 10	·	1501.89	」] (98)
									2(5	0,1	.12	1501.05] (30)
Space heating re	equirement	kWh/m²/ve	ar							(98)	÷ (4)	28.88	(99)
Space heating re	equirement	kWh/m²/ye	ear							(98)	÷ (4)	28.88	(99)
Space heating re 9a. Energy req	•			stems inclu	iding micro	-CHP				(98)	÷ (4)	28.88	(99)
	•			stems inclu	iding micro	-CHP				(98)	÷ (4)	28.88	
9a. Energy req	uirements -	individual	heating sys							(98)	÷ (4)	28.88] (99)] (201)
9a. Energy req Space heating Fraction of space Fraction of space	uirements - e heat from e heat from	individual secondary, main syste	heating sys /suppleme m(s)							(98) 1 - (2] (201)] (202)
9a. Energy requestions of space heating Fraction of space	uirements - e heat from e heat from	individual secondary, main syste	heating sys /suppleme m(s)							1 - (2	01) =	0.00] (201)] (202)] (202)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total	uirements - e heat from e heat from e heat from space heat	individual secondary, main syste main syste from main	heating sys /supplemen m(s) m 2 system 1						(20	1 - (20 02) × [1- (20	D1) = []] =	0.00 1.00 0.00 1.00] (201)] (202)] (202)] (202)] (204)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total	uirements - e heat from e heat from e heat from space heat space heat	individual secondary, main syste main syste from main from main	heating sys /supplemen m(s) m 2 system 1						(20	1 - (2	D1) = []] =	0.00 1.00 0.00 1.00 0.00] (201)] (202)] (202)] (202)] (204)] (205)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total	e heat from e heat from e heat from e heat from space heat space heat in system 1	individual secondary, main syste main syste from main from main (%)	heating sys /supplemen m(s) m 2 system 1 system 2	ntary syste	m (table 11)				1 - (20 02) x [1- (20 (202) x (20	01) = 3)] = 03) =	0.00 1.00 0.00 1.00 0.00 90.00] (201)] (202)] (202)] (202)] (204)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma	e heat from e heat from e heat from space heat space heat in system 1 Jan	individual secondary, main syste main syste from main from main (%) Feb	heating sys /supplemen m(s) m 2 system 1 system 2 Mar				Jul	Aug	(20 Sep	1 - (20 02) × [1- (20	D1) = []] =	0.00 1.00 0.00 1.00 0.00] (201)] (202)] (202)] (202)] (204)] (205)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total	e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May) Jun	1	-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct	01) = 3)] = 03) = Nov	0.00 1.00 0.00 1.00 0.00 90.00 Dec] (201)] (202)] (202)] (202)] (204)] (205)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma	e heat from e heat from e heat from space heat space heat in system 1 Jan	individual secondary, main syste main syste from main from main (%) Feb	heating sys /supplemen m(s) m 2 system 1 system 2 Mar	ntary syste	m (table 11)	Jul 0.00	Aug 0.00	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 123.37	01) = 3)] = 03) = Nov 221.79	0.00 1.00 1.00 1.00 90.00 90.00 Dec 321.42] (201)] (202)] (202)] (204)] (205)] (206)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu	e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May) Jun	1	-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct	01) = 3)] = 03) = Nov 221.79	0.00 1.00 0.00 1.00 0.00 90.00 Dec] (201)] (202)] (202)] (202)] (204)] (205)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating	e heat from e heat from e heat from e heat from space heat space heat in system 1 Jan Jan Jan Jan Jan Jan Jan	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May) Jun	1	-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 123.37	01) = 3)] = 03) = Nov 221.79	0.00 1.00 1.00 1.00 90.00 90.00 Dec 321.42] (201)] (202)] (202)] (204)] (205)] (206)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu	e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 315.53	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 255.23	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 221.63	Apr 136.98	m (table 11 May 72.82) Jun 0.00	0.00	0.00	Sep 0.00 Σ(21	1 - (2))2) x [1- (20) (202) x (2) Oct 123.37 1)15, 10	01) = 3)] = 03) = Nov 221.79 12 =	0.00 1.00 0.00 1.00 90.00 Dec 321.42 1668.76] (201)] (202)] (202)] (204)] (205)] (206)] (206)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating Efficiency of wat	e heat from e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 315.53 ter heater 88.86	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 255.23	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May) Jun	1	-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 123.37	01) = 3)] = 03) = Nov 221.79	0.00 1.00 1.00 1.00 90.00 90.00 Dec 321.42] (201)] (202)] (202)] (204)] (205)] (206)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating	e heat from e heat from e heat from e heat from space heat space heat in system 1 Jan Jan Jel (main sy 315.53 ter heater 88.86 uel, kWh/m	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 255.23 88.80 onth	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 221.63	Apr 136.98 88.34	May 72.82 87.84) Jun 0.00 86.70	0.00 86.70	0.00	Sep 0.00 Σ(21 86.70	1 - (2))2) x [1- (20) (202) x (2) Oct 123.37 1)15, 10 88.22	01) = 3)] = 03) = Nov 221.79 12 = 88.66	0.00 1.00 0.00 1.00 90.00 Dec 321.42 1668.76 88.90] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating Efficiency of wat	e heat from e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 315.53 ter heater 88.86	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 255.23	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 221.63	Apr 136.98	m (table 11 May 72.82) Jun 0.00	0.00	0.00	Sep 0.00 Σ(21	1 - (20)2) × [1- (20 (202) × (20 Oct 123.37 1)15, 10 88.22 141.96	01) = 3)] = 03) = Nov 221.79 12 = 88.66 147.59	0.00 1.00 0.00 1.00 0.00 90.00 Dec 321.42 1668.76 888.90 888.90] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)
 9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating Efficiency of wat Water heating fu 	e heat from e heat from e heat from e heat from space heat space heat in system 1 Jan Jan Jel (main sy 315.53 ter heater 88.86 uel, kWh/m	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 255.23 88.80 onth	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 221.63	Apr 136.98 88.34	May 72.82 87.84) Jun 0.00 86.70	0.00 86.70	0.00	Sep 0.00 Σ(21 86.70	1 - (2))2) x [1- (20) (202) x (2) Oct 123.37 1)15, 10 88.22	01) = 3)] = 03) = Nov 221.79 12 = 88.66 147.59	0.00 1.00 0.00 1.00 90.00 Dec 321.42 1668.76 88.90] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)
 9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating fu Water heating fu Water heating fu Annual totals 	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 315.53 ter heater 88.86 uel, kWh/m 161.47	individual secondary, main syste from main from main (%) Feb stem 1), kW 255.23 88.80 onth 142.34	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 221.63	Apr 136.98 88.34	May 72.82 87.84) Jun 0.00 86.70	0.00 86.70	0.00	Sep 0.00 Σ(21 86.70	1 - (20)2) × [1- (20 (202) × (20 Oct 123.37 1)15, 10 88.22 141.96	01) =	0.00 1.00 0.00 1.00 0.00 90.00 Dec 321.42 1668.76 88.90 88.90 157.44 1677.67] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)
 9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating Efficiency of wate Water heating fu Water heating fu Annual totals Space heating fu 	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 315.53 ter heater 88.86 uel, kWh/m 161.47	individual secondary, main syste from main from main (%) Feb stem 1), kW 255.23 88.80 onth 142.34	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 221.63	Apr 136.98 88.34	May 72.82 87.84) Jun 0.00 86.70	0.00 86.70	0.00	Sep 0.00 Σ(21 86.70	1 - (20)2) × [1- (20 (202) × (20 Oct 123.37 1)15, 10 88.22 141.96	01) =	0.00 1.00 0.00 1.00 0.00 90.00 Dec 321.42 1668.76 888.90 157.44 1677.67] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)
 9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating fu Water heating fu Water heating fu Annual totals 	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 315.53 ter heater 88.86 uel, kWh/m 161.47 uel - main sy uel	individual secondary, main syste from main from main (%) Feb stem 1), kW 255.23 88.80 onth 142.34	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 221.63 88.65 150.28	Apr 136.98 88.34 136.41	May 72.82 87.84) Jun 0.00 86.70	0.00 86.70	0.00	Sep 0.00 Σ(21 86.70	1 - (20)2) × [1- (20 (202) × (20 Oct 123.37 1)15, 10 88.22 141.96	01) =	0.00 1.00 0.00 1.00 0.00 90.00 Dec 321.42 1668.76 88.90 88.90 157.44 1677.67] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)

			J	.
	Energy kWh/year	Emission factor kg CO₂/kWh	Emissions kg CO₂/year	
12a. CO2 emissions - individual heating systems includ	ing micro-CHP			
SAP band			В	
SAP rating (section 13)			82] (258) ר
SAP value			82.39	
Energy cost factor (ECF)			1.26] (257) ר
Energy cost deflator (Table 12)			0.42	(256)
11a. SAP rating - individual heating systems including	micro-CHP			
Total energy cost		(240)(242) + (245)(254) =	291.62	(255)
Additional standing charges			120.00	(251)
Electricity for lighting	343.25	x 13.19 x 0.01 =	45.27	(250)
Pumps and fans	75.00	x 13.19 x 0.01 =	9.89	(249)
Water heating	1677.67	x 3.48 x 0.01 =	58.38	(247)
Space heating - main system 1	1668.76	x 3.48 x 0.01 =	58.07	(240)
	kWh/year		cost £/year	
	Fuel	Fuel price	Fuel	
10a. Fuel costs - individual heating systems including r	nicro-CHP			
Total delivered energy for all uses		(211)(221) + (231) + (232)(237b) =	3764.68	(238)
Electricity for lighting (Appendix L)			343.25	(232)
Total electricity for the above, kWh/year			75.00	(231)
boiler flue fan		45.00		(230e)
central heating pump or water pump within warm air	r heating unit	30.00		(230c)

Space heating - main system 1	1668.76	x	0.22	=	360.45	(261)
Water heating	1677.67	х	0.22	=	362.38	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	722.83	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	343.25	x	0.52	=	178.15	(268)
Total CO ₂ , kg/year				(265)(271) =	939.90	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) =	18.08	(273)
El value					87.02]
El rating (section 14)					87	(274)
El band					В	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1668.76	x	1.22	=	2035.89	(261)
Water heating	1677.67	x	1.22	=	2046.76	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	4082.65	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	343.25	x	3.07	=	1053.78	(268)
Primary energy kWh/year					5366.68	(272)
Dwelling primary energy rate kWh/m2/year					103.21	(273)



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Andre	w Alford					As	sessor num	ber	1003		
Client							La	st modified		25/05	/2016	
Address	179-181	High Street	t, Hampton	Hill. TW12	21							
		0	-,	•								
1. Overall dwelling dimens	sions											
				Α	area (m²)			age storey eight (m)		Vo	olume (m³)	
Lowest occupied					52.00	(1a) x		2.40	(2a) =		124.80	(3a)
Total floor area	(1a)	+ (1b) + (1	c) + (1d)(1n) =	52.00	(4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3	n) =	124.80	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								0	x 40 =		0	(6a)
Number of open flues								0	x 20 =		0	(6b)
Number of intermittent fan	S							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 pe hour	r
Infiltration due to chimneys	flues fans	: PSVs		(6a)) + (6b) + (7	'a) + (7b) + (7c) =	20	÷ (5) =		0.16	(8)
If a pressurisation test has b			intended, p				·	-] . (3) =		0.10	
Air permeability value, q50,								- (/			4.50	(17)
If based on air permeability											0.39	(18)
Number of sides on which t				-,,	() (-						2	(19)
Shelter factor								1 -	[0.075 x (19	9)] =	0.85	(20)
Infiltration rate incorporatir	ng shelter fa	actor							(18) x (2		0.33	(21)
Infiltration rate modified fo	-		l:						(,(-			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee	d from Tab	le U2		·			Ū					
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4			-		•				II			
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (al	1					1	1	1	II			
0.42	0.41	0.40	0.36	0.35	0.31	0.31	0.30	0.33	0.35	0.37	0.38	(22b)
Calculate effective air chang				ı		-1			ıI			,
If mechanical ventilation	1: air change	e rate thro	ugh system	1							N/A	(23a)
If balanced with heat red	•				ctor from ⁻	Table 4h					N/A	(23c)
d) natural ventilation or	-	-	-									
0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)
Effective air change rate - e												_ · ·
0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)
L	ı I								·I			*



3. Heat losses	and heat lo	ss paramet	er										
Element				Gross rea, m²	Openings m ²		area m²	U-value W/m²K	A x U W		/alue, /m².K	Ахк, kJ/K	
Roof window						0.	80 x	1.50	= 1.20				(27a)
Window						5.	36 x	1.26	= 6.77				(27)
External wall						36	.34 x	0.22	= 7.99				(29a)
Party wall						41	.10 x	0.00	= 0.00				(32)
Roof						53	.87 x	0.12	= 6.46				(30)
Roof						40	.16 x	0.13	= 5.22				(30)
Total area of ex	ternal eleme	ents ∑A, m²	:			136	6.53						(31)
Fabric heat loss	, W/K = ∑(A	× U)							(26	5)(30) + (3	32) =	27.65	(33)
Heat capacity C	m = ∑(А x к)							(28)	.(30) + (32) +	+ (32a)(3	2e) =	N/A	(34)
Thermal mass p	arameter (T	MP) in kJ/n	n²K									100.00	(35)
Thermal bridges	s: Σ(L x Ψ) ca	alculated us	sing Appen	dix K								3.29	(36)
Total fabric hea			0 11							(33) + (3	36) =	30.94	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	t loss calcula	ited month	ly 0.33 x (2		·			, in the second s	·				
	24.18	24.04	23.91	23.26	23.14	22.58	22.58	22.48	22.80	23.14	23.39	23.64	(38)
Heat transfer co	oefficient, W	//K (37)m +	+ (38)m										
	55.12	54.98	54.84	54.20	54.08	53.52	53.52	53.42	53.74	54.08	54.33	54.58	
									Average = ∑	(39)112/	/12 =	54.20	(39)
Heat loss param	neter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.06	1.06	1.05	1.04	1.04	1.03	1.03	1.03	1.03	1.04	1.04	1.05	
									Average = ∑	(40)112/	/12 =	1.04	(40)
Number of days	in month (1	Fable 1a)											
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heati	ing energy r	equiremen	t										
Assumed occup	ancy, N											1.75	(42)
Annual average	hot water u	isage in litro	es per day	Vd,average	= (25 x N) +	36						75.74	(43)
-	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage	e in litres pe	r day for ea	ach month	Vd,m = fact	tor from Tab	le 1c x (43	3)						
-	83.31	80.28	77.26	74.23	71.20	68.17	68.17	71.20	74.23	77.26	80.28	83.31	7
	L						1			∑(44)1	.12 =	908.89	(44)
Energy content	of hot wate	r used = 4.1	L8 x Vd.m x	nm x Tm/3	3600 kWh/m	onth (see	Tables 1b). 1c 1d)		21			_ ` `
0,	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65	٦
										∑(45)1	·	1191.69	(45)
Distribution loss	s 0.15 x (45))m								2()=			
	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95	(46)
Water storage l		1			10.00	12.07	11.15	12.01	12.55	13.11	10.55	17.55	
Water Storage I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel cor									0.00	0.00	0.00	0.00	_ (50)
ii the vessel col			-		· · ·			-1	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit I		1	1	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Comp: los-f-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for e					20.44	27.20	20.44	20.44	27.20	20.44	27.20	20.44	
Total heat requi	38.44	34.72	38.44	37.20	38.44	37.20	38.44	38.44	37.20	38.44	37.20	38.44	(61)
TOTAL DEAL LEDU	neu ior Wat	ei neating (laiculated I	ioi each ma	JIILII U.OD X (43/11 + (4	0,111 + (5/)	111 + (23)[[].	- (OT)[]]				

	161.99	142.78	149.94	134.41	131.72	117.69	113.03	124.03	123.81	139.38	147.38	158.09	(62)
Solar DHW inpu	t calculated	using Appe	endix G or A	Appendix H							I	1	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Flue gas heat re	covery syste	em 1 input	(Appendix (G1)			1	1	II		1	1	
C	-18.52	-16.39	-16.74	-13.93	-12.60	-10.11	-9.57	-10.69	-10.73	-14.18	-16.55	-18.16	(63)
Output from wa			1										
	143.46	126.38	133.20	120.48	119.12	107.58	103.46	113.34	113.08	125.20	130.83	139.93	7
										∑(64)1	.12 = 1	L476.06	(64)
Heat gains from	water heat	ing (kWh/n	nonth) 0.25	5 × [0.85 × ((45)m + (61)m] + 0.8 ×	: [(46)m + (!	57)m + (59)	m]	2(-)			
0	50.69	44.61	46.69	41.62	40.62	36.06	34.41	38.07	38.10	43.17	45.94	49.39	(65)
] (7
5. Internal gair	IS												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	104.94	(66)
Lighting gains (c	alculated in	Appendix	L, equation	L9 or L9a),	also see Ta	ble 5							
	38.87	34.53	28.08	21.26	15.89	13.42	14.50	18.84	25.29	32.11	37.48	39.95	(67)
Appliance gains	(calculated	in Appendi	ix L, equatic	on L13 or L1	3a), also se	e Table 5							
	227.50	229.86	223.91	211.25	195.26	180.24	170.20	167.84	173.79	186.45	202.44	217.46	(68)
Cooking gains (c	alculated in	Appendix	L, equation	L15 or L15	a), also see	Table 5							
	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	47.24	(69)
Pump and fan g	ains (Table 5	5a)											
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evap	oration (Tak	ole 5)									•		-
	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
Water heating g			-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
Water heating g			-69.96 62.75	-69.96 57.81	-69.96 54.60	-69.96	-69.96 46.25	-69.96	-69.96 52.91	-69.96	-69.96 63.80	-69.96 66.39] (71)] (72)
Water heating g Total internal ga	ains (Table 68.13	5) 66.38	62.75	57.81	54.60	50.09					1	1	-
	ains (Table) 68.13 ins (66)m +	5) 66.38 - (67)m + (6	62.75 58)m + (69)i	57.81 m + (70)m -	54.60 + (71)m + (7	50.09 72)m	46.25	51.17	52.91	58.03	63.80	66.39] (72)
	ains (Table 68.13	5) 66.38	62.75	57.81	54.60	50.09					1	1	-
	ains (Table) 68.13 ins (66)m +	5) 66.38 - (67)m + (6	62.75 58)m + (69)i	57.81 m + (70)m -	54.60 + (71)m + (7	50.09 72)m	46.25	51.17	52.91	58.03	63.80	66.39] (72)
Total internal ga	ains (Table) 68.13 ins (66)m +	5) 66.38 - (67)m + (6	62.75 58)m + (69)i 399.97 Access f	57.81 m + (70)m - 375.54	54.60 + (71)m + (7 350.98 Area	50.09 72)m 328.96 Sol	46.25 316.17 ar flux	51.17	52.91 337.22 g	58.03 361.81 FF	63.80 388.94	66.39 409.03 Gains] (72)
Total internal ga	ains (Table) 68.13 ins (66)m +	5) 66.38 - (67)m + (6	62.75 58)m + (69)r 399.97	57.81 m + (70)m - 375.54	54.60 + (71)m + (7 350.98	50.09 72)m 328.96 Sol	46.25	51.17 323.07 spec	52.91 337.22 g ific data	58.03 361.81 FF specific c	63.80 388.94	66.39 409.03] (72)
Total internal ga	ains (Table) 68.13 ins (66)m +	5) 66.38 - (67)m + (6	62.75 58)m + (69)n 399.97 Access f Table	57.81 m + (70)m - 375.54 actor 6d	54.60 + (71)m + (7 350.98 Area m ²	50.09 72)m 328.96 Sol W	46.25 316.17 ar flux //m ²	51.17 323.07 spec or T	52.91 337.22 g ific data able 6b	58.03 361.81 FF specific c or Table	63.80 388.94 Jata	66.39 409.03 Gains W] (72)] (73)
Total internal ga 6. Solar gains West	ains (Table) 68.13 ins (66)m +	5) 66.38 - (67)m + (6	62.75 58)m + (69) 399.97 Access f Table	57.81 m + (70)m - 375.54 actor 6d	54.60 + (71)m + (7 350.98 Area m ² 0.80	50.09 72)m 328.96 Sol W	46.25 316.17 ar flux //m ² 9.64 x	51.17 323.07 spec or T 0.9 x	52.91 337.22 g ific data able 6b 0.72 x	58.03 361.81 FF specific c or Table 0.80	63.80 388.94 data 6c	66.39 409.03 Gains W 8.15] (72)] (73)] (80)
Total internal ga 6. Solar gains West West	ains (Table : 68.13 ins (66)m + 419.73	5) 66.38 - (67)m + (6 416.00	62.75 58)m + (69)n 399.97 Access f Table	57.81 m + (70)m - 375.54 actor 6d	54.60 + (71)m + (7 350.98 Area m ²	50.09 72)m 328.96 Sol W	46.25 316.17 ar flux //m ² 9.64 x	51.17 323.07 spec or T 0.9 x	52.91 337.22 g ific data able 6b	58.03 361.81 FF specific c or Table 0.80	63.80 388.94 Jata	66.39 409.03 Gains W] (72)] (73)
Total internal ga 6. Solar gains West	ains (Table 5 68.13 ins (66)m + 419.73	5) 66.38 - (67)m + (6 416.00	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36	50.09 72)m 328.96 Sol M 2 x 1 x 1	46.25 316.17 ar flux //m ² 9.64 x 9.64 x	51.17 323.07 spec or T 0.9 x (0) 0.9 x (0)	52.91 337.22 ific data able 6b 0.72 x 0.72 x	58.03 361.81 FF specific c or Table 0.80 0.70	63.80 388.94 data 6c = =	66.39 409.03 Gains W 8.15 25.79] (72)] (73)] (80)] (80)
Total internal ga 6. Solar gains West West Solar gains in wa	ains (Table : 68.13 ins (66)m + 419.73 atts ∑(74)m 33.93	5) 66.38 - (67)m + (6 416.00 (82)m 66.38	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54	57.81 m + (70)m - 375.54 actor 6d	54.60 + (71)m + (7 350.98 Area m ² 0.80	50.09 72)m 328.96 Sol W	46.25 316.17 ar flux //m ² 9.64 x	51.17 323.07 spec or T 0.9 x	52.91 337.22 g ific data able 6b 0.72 x	58.03 361.81 FF specific c or Table 0.80	63.80 388.94 data 6c	66.39 409.03 Gains W 8.15] (72)] (73)] (80)
Total internal ga 6. Solar gains West West	ains (Table : 68.13 ins (66)m + 419.73 atts ∑(74)m 33.93 ernal and so	5) 66.38 - (67)m + (6 416.00 (82)m 66.38 lar (73)m +	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 - (83)m	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38	50.09 72)m 328.96 Sol W 328.96	46.25 316.17 ar flux V/m ² 9.64 x 9.64 x 190.42	51.17 323.07 spec or T 0.9 x () 0.9 x () 163.56	52.91 337.22 ific data able 6b 0.72 x 0.72 x 127.13	58.03 361.81 FF specific c or Table 0.80 0.70 78.76	63.80 388.94 data 6c = = 42.31	66.39 409.03 Gains W 8.15 25.79 27.90] (72)] (73)] (80)] (80)] (80)] (83)
Total internal ga 6. Solar gains West West Solar gains in wa	ains (Table : 68.13 ins (66)m + 419.73 atts ∑(74)m 33.93	5) 66.38 - (67)m + (6 416.00 (82)m 66.38	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36	50.09 72)m 328.96 Sol M 2 x 1 x 1	46.25 316.17 ar flux //m ² 9.64 x 9.64 x	51.17 323.07 spec or T 0.9 x (0) 0.9 x (0)	52.91 337.22 ific data able 6b 0.72 x 0.72 x	58.03 361.81 FF specific c or Table 0.80 0.70	63.80 388.94 data 6c = =	66.39 409.03 Gains W 8.15 25.79] (72)] (73)] (80)] (80)
Total internal ga 6. Solar gains West West Solar gains in wa	ains (Table : 68.13 ins (66)m + 419.73 atts ∑(74)m 33.93 ernal and so 453.66	5) 66.38 - (67)m + (6 416.00 (82)m 66.38 lar (73)m + 482.37	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 - (83)m 509.28	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38	50.09 72)m 328.96 Sol W 328.96	46.25 316.17 ar flux V/m ² 9.64 x 9.64 x 190.42	51.17 323.07 spec or T 0.9 x () 0.9 x () 163.56	52.91 337.22 ific data able 6b 0.72 x 0.72 x 127.13	58.03 361.81 FF specific c or Table 0.80 0.70 78.76	63.80 388.94 data 6c = = 42.31	66.39 409.03 Gains W 8.15 25.79 27.90] (72)] (73)] (80)] (80)] (80)] (83)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - inte	ains (Table 5 68.13 ins (66)m + 419.73 419.73 atts Σ(74)m 33.93 ernal and so 453.66 al tempera	5) 66.38 - (67)m + (6 416.00 (82)m 66.38 lar (73)m + 482.37 ture (heati	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 · (83)m 509.28 ng season)	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42 534.97	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38 195.38	50.09 72)m 328.96 Sol W 328.97	46.25 316.17 ar flux V/m ² 9.64 x 9.64 x 190.42	51.17 323.07 spec or T 0.9 x () 0.9 x () 163.56	52.91 337.22 ific data able 6b 0.72 x 0.72 x 127.13	58.03 361.81 FF specific c or Table 0.80 0.70 78.76	63.80 388.94 data 6c = [42.31 431.25	66.39 409.03 Gains W 8.15 25.79 27.90] (72)] (73)] (80)] (80)] (80)] (83)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern	ains (Table 5 68.13 ins (66)m + 419.73 419.73 atts Σ(74)m 33.93 ernal and so 453.66 al tempera	5) 66.38 - (67)m + (6 416.00 (82)m 66.38 lar (73)m + 482.37 ture (heati	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 · (83)m 509.28 ng season)	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42 534.97	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38 195.38	50.09 72)m 328.96 Sol W 328.97	46.25 316.17 ar flux V/m ² 9.64 x 9.64 x 190.42	51.17 323.07 spec or T 0.9 x () 0.9 x () 163.56	52.91 337.22 ific data able 6b 0.72 x 0.72 x 127.13	58.03 361.81 FF specific c or Table 0.80 0.70 78.76	63.80 388.94 data 6c = [42.31 431.25	66.39 409.03 Gains W 8.15 25.79 27.90 436.93] (72)] (73)] (80)] (80)] (83)] (83)] (84)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern	ains (Table 1 68.13 ins (66)m + 419.73 419.73 33.93 ernal and so 453.66 al temperation Jan	5) 66.38 (67)m + (6 416.00 (82)m 66.38 lar (73)m + 482.37 ture (heati g periods in Feb	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 · (83)m 509.28 ng season) n the living a Mar	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42 534.97 area from T Apr	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38 195.38 546.36	50.09 72)m 328.96 Sol M 200.01 528.97 (°C)	46.25 316.17 ar flux //m ² 9.64 x 9.64 x 9.64 x 190.42 506.58	51.17 323.07 spec or T 0.9 x (0 0.9 x (0 163.56 486.64	52.91 337.22 g ific data able 6b 0.72 x 0.72 x 127.13 464.35	58.03 361.81 FF specific c or Table 0.80 0.70 78.76 440.57	63.80 388.94 data 6c = [42.31 431.25	66.39 409.03 Gains W 8.15 25.79 27.90 436.93 21.00] (72)] (73)] (80)] (80)] (83)] (83)] (84)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern Temperature du	ains (Table 1 68.13 ins (66)m + 419.73 419.73 33.93 ernal and so 453.66 al temperation Jan	5) 66.38 (67)m + (6 416.00 (82)m 66.38 lar (73)m + 482.37 ture (heati g periods in Feb	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 · (83)m 509.28 ng season) n the living a Mar	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42 534.97 area from T Apr	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38 195.38 546.36	50.09 72)m 328.96 Sol M 200.01 528.97 (°C)	46.25 316.17 ar flux //m ² 9.64 x 9.64 x 9.64 x 190.42 506.58	51.17 323.07 spec or T 0.9 x (0 0.9 x (0 163.56 486.64	52.91 337.22 g ific data able 6b 0.72 x 0.72 x 127.13 464.35	58.03 361.81 FF specific c or Table 0.80 0.70 78.76 440.57	63.80 388.94 data 6c = [42.31 431.25	66.39 409.03 Gains W 8.15 25.79 27.90 436.93 21.00] (72)] (73)] (80)] (80)] (80)] (83)] (84)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern 7. Mean intern Temperature du	ains (Table 1 68.13 ins (66)m + 419.73 419.73 33.93 ernal and so 453.66 al temperation ring heating Jan r for gains for 0.92	5) 66.38 (67)m + (6 416.00 (416.00) (416.00)	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 (83)m 509.28 ng season) n the living a Mar ea n1,m (se 0.87	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42 534.97 area from T Apr e Table 9a) 0.80	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38 195.38 546.36 able 9, Th1 May 0.70	50.09 72)m 328.96 Sol M 328.97 X 1 200.01 528.97 (°C) Jun	46.25 316.17 ar flux //m ² 9.64 x 9.64 x 190.42 506.58 Jul	51.17 323.07 spec or T 0.9 x (0 0.9 x (0 163.56 486.64 486.64	52.91 337.22 g ific data able 6b 0.72 x 0.72 x 127.13 464.35 Sep	58.03 361.81 FF specific c or Table 0.80 0.70 78.76 440.57	63.80 388.94 data 6c = [42.31 431.25 Nov	66.39 409.03 Gains W 8.15 25.79 27.90 436.93 21.00 Dec] (72)] (73)] (80)] (80)] (83)] (83)] (84)] (85)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern Temperature du Utilisation facto	ains (Table 1 68.13 ins (66)m + 419.73 419.73 33.93 ernal and so 453.66 al temperation ring heating Jan r for gains for 0.92	5) 66.38 (67)m + (6 416.00 (416.00) (416.00)	62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 (83)m 509.28 ng season) n the living a Mar ea n1,m (se 0.87	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42 534.97 area from T Apr e Table 9a) 0.80	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38 195.38 546.36 able 9, Th1 May 0.70	50.09 72)m 328.96 Sol M 328.97 X 1 200.01 528.97 (°C) Jun	46.25 316.17 ar flux //m ² 9.64 x 9.64 x 190.42 506.58 Jul	51.17 323.07 spec or T 0.9 x (0 0.9 x (0 163.56 486.64 486.64	52.91 337.22 g ific data able 6b 0.72 x 0.72 x 127.13 464.35 Sep	58.03 361.81 FF specific c or Table 0.80 0.70 78.76 440.57	63.80 388.94 data 6c = [42.31 431.25 Nov	66.39 409.03 Gains W 8.15 25.79 27.90 436.93 21.00 Dec] (72)] (73)] (80)] (80)] (83)] (83)] (84)] (85)
Total internal ga 6. Solar gains West West Solar gains in wa Total gains - intern Temperature du Utilisation facto	ains (Table 2 68.13 ins (66)m + 419.73 419.73 33.93 ernal and so 453.66 al temperation ring heating Jan r for gains for 0.92 emp of living 19.22	5) 66.38 (67)m + (6 416.00 (416.00)) (416.00) (62.75 58)m + (69) 399.97 Access f Table 1.00 0.54 109.31 (83)m 509.28 ng season) n the living a Mar ea n1,m (se 0.87 steps 3 to 7 19.75	57.81 m + (70)m - 375.54 actor 6d 0 x [4 x [159.42 534.97 area from T Apr e Table 9a) 0.80 in Table 9c 20.20	54.60 + (71)m + (7 350.98 Area m ² 0.80 5.36 195.38 195.38 546.36 3ble 9, Th1 May 0.70) 20.58	50.09 72)m 328.96 Sol V 200.01 200.01 528.97 (°C) Jun 0.56 20.84	46.25 316.17 ar flux //m ² 9.64 x 9.64 x 190.42 506.58 Jul 0.43	51.17 323.07 spec or T 0.9 x (0 0.9 x (0 163.56 486.64 486.64 Aug 0.47	52.91 337.22 g ific data able 6b 0.72 x 0.72 x 127.13 464.35 Sep 0.65	58.03 361.81 FF specific c or Table 0.80 0.70 78.76 440.57 440.57	63.80 388.94 data 6c = [42.31 431.25 Nov 0.90	66.39 409.03 Gains W 8.15 25.79 27.90 436.93 21.00 Dec 0.93] (72)] (73)] (73)] (80)] (80)] (83)] (83)] (84)] (85)] (86)

	20.03	20.04	20.04	20.05	20.05	20.06	20.06	20.06	20.06	20.05	20.05	20.04	(88)
Utilisation factor						20.00	20.00		20.00	20100	20.00	20.01] (00)
	0.91	0.89	0.85	0.78	0.66	0.50	0.35	0.38	0.59	0.79	0.88	0.92	(89)
Mean internal te	L							0.50	0.55	0.75	0.00	0.52] (03)
	18.43	18.61	18.94	19.38	19.73	19.96	20.03	20.03	19.89	19.46	18.89	18.39	(90)
Living area fract		10.01	10.94	19.30	19.75	19.90	20.03	20.03	1		·		
Living area fract		for the wh	مام طبيرمالنم	~ fl A v T1 v	(1 fl A) v	5			LI	ving area ÷	(4) =	0.52	(91)
Mean internal te				1	1		20.54	20.50	20.24	10.00	10.21	10.00	
A secolo conditionation of	18.84	19.02	19.36	19.80	20.17	20.42	20.51	20.50	20.34	19.89	19.31	18.80	(92)
Apply adjustmer				1	1		1			1 -		1	٦
	18.69	18.87	19.21	19.65	20.02	20.27	20.36	20.35	20.19	19.74	19.16	18.65	93) (93)
8. Space heatir	ng requirem	ient											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains,	ηm											
	0.89	0.87	0.84	0.77	0.66	0.51	0.38	0.41	0.60	0.78	0.86	0.90	(94)
Useful gains, ηm	nGm, W (94	l)m x (84)m											_
	405.91	421.95	425.87	409.71	360.96	272.30	191.64	198.85	277.65	341.93	372.95	394.24	(95)
Monthly average	e external t	emperature	e from Tabl	e U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate fo	or mean inte	ernal tempe	erature, Lm	, W [(39)m	ı x [(93)m -	(96)m]				1	1], ,
	793.02	768.28	697.19	582.82	449.96	303.34	201.04	210.80	327.09	494.12	654.92	788.76	(97)
Space heating re				1									
	288.01	232.73	201.86	124.64	66.22	0.00	0.00	0.00	0.00	113.23	203.01	293.53	T
			202.00		00.22	0.00		0.00		8)15, 10	·	1523.22	_] (98)
									2(5)	0/1		1010111	(00)
Space heating re	auirement	kWh/m²/ve	ar							(98)	÷ (4)	29.29	(99)
Space heating re	equirement	kWh/m²/ye	ear							(98)	÷ (4)	29.29	(99)
Space heating re 9a. Energy requ				stems inclu	iding micro	-CHP				(98)	÷ (4)	29.29] (99)
				stems inclu	iding micro	-CHP				(98)	÷ (4)	29.29] (99)
9a. Energy requ	uirements -	individual	heating sys							(98)	÷ (4)	29.29] (99)] (201)
9a. Energy requ Space heating	uirements - e heat from	individual secondary,	heating sys /suppleme							(98) 1 - (2			
9a. Energy request of space heating Fraction of space fraction fra	uirements - e heat from e heat from	individual secondary, main syste	heating sys /suppleme em(s)									0.00] (201)
9a. Energy request of space heating Fraction of space fraction fra	uirements - e heat from e heat from e heat from	individual secondary, main syste main syste	heating sys /suppleme m(s) m 2						(20		D1) =	0.00] (201)] (202)
9a. Energy request of space heating Fraction of space Fraction Fraction Space Fraction Space Fraction Space Fraction Fraction Space Fraction Fraction Fraction Space Fraction Fracti	uirements - e heat from e heat from e heat from space heat	individual secondary, main syste main syste from main	heating sys /supplemen m(s) m 2 system 1						(20	1 - (2	D1) = 3)] =	0.00 1.00 0.00] (201)] (202)] (202)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total	uirements - e heat from e heat from e heat from space heat space heat	individual secondary, main syste main syste from main from main	heating sys /supplemen m(s) m 2 system 1						(20	1 - (20 02) × [1- (20	D1) = 3)] =	0.00 1.00 0.00 1.00] (201)] (202)] (202)] (202)] (204)
9a. Energy requests of space heating Praction of space Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Fraction of total	uirements - e heat from e heat from e heat from space heat space heat	individual secondary, main syste main syste from main from main	heating sys /supplemen m(s) m 2 system 1				Jul	Aug	(20 Sep	1 - (20 02) × [1- (20	D1) = 3)] =	0.00 1.00 0.00 1.00 0.00] (201)] (202)] (202)] (204)] (205)
9a. Energy requests of space heating Praction of space Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Fraction of total	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan	individual secondary, main syste main syste from main from main (%) Feb	heating sys /supplement m(s) m 2 system 1 system 2 Mar	ntary syste	m (table 11	.)	Jul	Aug		1 - (20 02) x [1- (20 (202) x (20	01) = 3)] = 03) =	0.00 1.00 0.00 1.00 0.00 90.00] (201)] (202)] (202)] (204)] (205)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan	individual secondary, main syste main syste from main from main (%) Feb	heating sys /supplement m(s) m 2 system 1 system 2 Mar	ntary syste	m (table 11	.)	Jul	Aug 0.00		1 - (20 02) x [1- (20 (202) x (20	01) = 3)] = 03) =	0.00 1.00 0.00 1.00 0.00 90.00] (201)] (202)] (202)] (204)] (205)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai	uirements - e heat from e heat from space heat space heat in system 1 Jan uel (main sy	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May	.) Jun		-	Sep	1 - (20 02) × [1- (20 (202) × (20 Oct	01) = 3)] = 03) = Nov 225.57	0.00 1.00 0.00 1.00 0.00 90.00 Dec] (201)] (202)] (202)] (204)] (205)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of main Space heating fu	uirements - e heat from e heat from space heat space heat in system 1 Jan uel (main sy	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May	.) Jun		-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 125.81	01) = 3)] = 03) = Nov 225.57	0.00 1.00 0.00 1.00 0.00 90.00 Dec 326.14] (201)] (202)] (202)] (204)] (205)] (206)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai	e heat from e heat from e heat from space heat space heat in system 1 Jan Jan Jan Jan Jan	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May	.) Jun		-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 125.81	01) = 3)] = 03) = Nov 225.57	0.00 1.00 0.00 1.00 0.00 90.00 Dec 326.14] (201)] (202)] (202)] (204)] (205)] (206)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai Space heating fu Water heating	e heat from e heat from e heat from space heat space heat in system 1 Jan Jan Jan Jan Jan	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 258.59	heating sys /supplement m(s) m 2 system 1 system 2 Mar /h/month 224.29	Apr 138.49	m (table 11 May 73.57) Jun 0.00	0.00	0.00	Sep 0.00 Σ(21	1 - (2))2) x [1- (20 (202) x (2) Oct 125.81 1)15, 10	01) = 3)] = 03) = Nov 225.57 12 =	0.00 1.00 0.00 1.00 90.00 Dec 326.14 1692.47] (201)] (202)] (202)] (204)] (205)] (206)] (206)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai Space heating fu Water heating Efficiency of wat	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 320.01 ter heater 88.88	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 258.59	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month	ntary syste	m (table 11 May	.) Jun		-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 125.81	01) = 3)] = 03) = Nov 225.57	0.00 1.00 0.00 1.00 0.00 90.00 Dec 326.14] (201)] (202)] (202)] (204)] (205)] (206)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai Space heating fu Water heating	e heat from e heat from e heat from space heat space heat in system 1 Jan Jan Jel (main sy 320.01 ter heater 88.88 uel, kWh/m	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 258.59 88.81 onth	heating sys /supplement m(s) m 2 system 1 system 2 Mar /h/month 224.29 88.66	Apr 138.49 88.35	m (table 11 May 73.57 87.85) Jun 0.00 86.70	0.00	0.00	Sep 0.00 Σ(21 86.70	1 - (2))2) x [1- (20) (202) x (2) Oct 125.81 1)15, 10 88.24	01) = 3)] = 03) = Nov 225.57 .12 = 88.68	0.00 1.00 0.00 1.00 90.00 Dec 326.14 1692.47 88.91] (201)] (202)] (202)] (204)] (205)] (206)] (206)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai Space heating fu Water heating Efficiency of wat	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 320.01 ter heater 88.88	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 258.59	heating sys /supplement m(s) m 2 system 1 system 2 Mar /h/month 224.29	Apr 138.49	m (table 11 May 73.57) Jun 0.00	0.00	0.00	Sep 0.00 Σ(21	1 - (20)2) × [1- (20 (202) × (20 Oct 125.81 1)15, 10 88.24 141.89	01) = 3)] = 03) = Nov 225.57 12 = 88.68 147.54	0.00 1.00 0.00 1.00 0.00 90.00 Dec 326.14 1692.47 88.91 88.91] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai Space heating fu Water heating Efficiency of wat	e heat from e heat from e heat from space heat space heat in system 1 Jan Jan Jel (main sy 320.01 ter heater 88.88 uel, kWh/m	individual secondary, main syste main syste from main from main (%) Feb stem 1), kW 258.59 88.81 onth	heating sys /supplement m(s) m 2 system 1 system 2 Mar /h/month 224.29 88.66	Apr 138.49 88.35	m (table 11 May 73.57 87.85) Jun 0.00 86.70	0.00	0.00	Sep 0.00 Σ(21 86.70	1 - (2))2) x [1- (20) (202) x (2) Oct 125.81 1)15, 10 88.24	01) = 3)] = 03) = Nov 225.57 12 = 88.68 147.54	0.00 1.00 0.00 1.00 90.00 Dec 326.14 1692.47 88.91] (201)] (202)] (202)] (204)] (205)] (206)] (206)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai Space heating fu Water heating Efficiency of wat Water heating fu	uirements - e heat from e heat from space heat space heat in system 1 Jan uel (main sy 320.01 ter heater 88.88 uel, kWh/m 161.42	individual secondary, main syste main syste from main (%) Feb stem 1), kW 258.59 88.81 onth 142.31	heating sys /supplement m(s) m 2 system 1 system 2 Mar /h/month 224.29 88.66	Apr 138.49 88.35	m (table 11 May 73.57 87.85) Jun 0.00 86.70	0.00	0.00	Sep 0.00 Σ(21 86.70	1 - (20)2) × [1- (20 (202) × (20 Oct 125.81 1)15, 10 88.24 141.89	01) =	0.00 1.00 0.00 1.00 0.00 90.00 Dec 326.14 1692.47 88.91 157.39 1677.31] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)
 9a. Energy required Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mail Space heating fu Water heating Efficiency of wate Water heating fu Water heating fu Annual totals Space heating fu 	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 320.01 ter heater 88.88 uel, kWh/m 161.42	individual secondary, main syste main syste from main (%) Feb stem 1), kW 258.59 88.81 onth 142.31	heating sys /supplement m(s) m 2 system 1 system 2 Mar /h/month 224.29 88.66	Apr 138.49 88.35	m (table 11 May 73.57 87.85) Jun 0.00 86.70	0.00	0.00	Sep 0.00 Σ(21 86.70	1 - (20)2) × [1- (20 (202) × (20 Oct 125.81 1)15, 10 88.24 141.89	01) =	0.00 1.00 0.00 1.00 90.00 Dec 326.14 1692.47 88.91 157.39 1677.31] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)
9a. Energy requ Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of mai Space heating fu Water heating Efficiency of wat Water heating fu	uirements - e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sy 320.01 ter heater 88.88 uel, kWh/m 161.42 uel - main sy uel	individual secondary, main syste main syste from main (%) Feb stem 1), kW 258.59 88.81 onth 142.31	heating sys /supplemen m(s) m 2 system 1 system 2 Mar /h/month 224.29 88.66 150.24	Apr 138.49 88.35 136.37	m (table 11 May 73.57 87.85) Jun 0.00 86.70	0.00	0.00	Sep 0.00 Σ(21 86.70	1 - (20)2) × [1- (20 (202) × (20 Oct 125.81 1)15, 10 88.24 141.89	01) =	0.00 1.00 0.00 1.00 0.00 90.00 Dec 326.14 1692.47 88.91 157.39 1677.31] (201)] (202)] (202)] (204)] (205)] (206)] (206)] (211)] (217)

central heating pump or water pump within warm air heating	unit		30.00			(230c)
boiler flue fan			45.00			(230e)
Total electricity for the above, kWh/year					75.00	(231)
Electricity for lighting (Appendix L)					274.60	(232)
Energy saving/generation technologies						
electricity generated by PV (Appendix M)					-798.52	(233)
Total delivered energy for all uses		(211))(221) + (231) + (2	232)(237b) =	2920.86	(238)
10a. Fuel costs - individual heating systems including micro-CH	IP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1692.47	x	3.48	x 0.01 =	58.90	(240)
Water heating	1677.31	x	3.48	x 0.01 =	58.37	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	274.60	x	13.19	x 0.01 =	36.22	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-798.52	x	13.19	x 0.01 =	0.00	(252)
Total energy cost			(240)(242) +	(245)(254) =	283.38	(255)
11a. SAP rating - individual heating systems including micro-CH	ΗP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.23	(257)
SAP value					82.88]
SAP rating (section 13)					83	(258)
SAP band					В]
12a. CO ₂ emissions - individual heating systems including micro	o-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	1692.47	x	0.22	=	365.57	(261)
Water heating	1677.31	x	0.22	=	362.30	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	727.87	(265)
Pumps and fans	75.00	х	0.52	=	38.93	(267)
Electricity for lighting	274.60	x	0.52	=	142.52	(268)
Energy saving/generation technologies						
pv savings	-798.52	x	0.52	=	-414.43	(269)
Total CO ₂ , kg/year				(265)(271) =	494.88	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) =	9.52	(273)
El value					93.16]
El rating (section 14)					93	(274)
El band					A]
13a. Primary energy - individual heating systems including mic	ro-CHP					
	Energy		Primary factor		Primary Energy	,

	Energy kWh/year		Primary factor		Primary Energy kWh/year	/
Space heating - main system 1	1692.47) x	1.22] =	2064.81	(261)
Water heating	1677.31) x	1.22] =	2046.32	(264)
Space and water heating			(261) + (262) +	- (263) + (264) =	4111.13	(265)
Pumps and fans	75.00] x	3.07] =	230.25	(267)

Electricity for lighting	274.60	x	3.07	=	843.02 (268)
Energy saving/generation technologies						
Electricity generated - PVs	-798.52	x	3.07	=	-2451.45 (269)
Primary energy kWh/year					2732.96 (272)
Dwelling primary energy rate kWh/m2/year					52.56 (273)



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Andre	w Alford					As	sessor num	ber	1003		
Client							La	st modified		25/05	/2016	
Address	179-181 H	ligh Street	, Hampto	n Hill, TW12	2 1NW							
1. Overall dwelling dime	nsions											
				A	area (m²)			age storey ight (m)		Vo	olume (m³)	
Lowest occupied					54.70] (1a) x		2.26] (2a) =		123.62	(3a)
Total floor area	(1a) +	+ (1b) + (1d	:) + (1d)	(1n) =	54.70	(4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3	sn) =	123.62	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								2	x 40 =		80	(6a)
Number of open flues								0	_ x 20 =		0	(6b)
Number of intermittent fa	ns							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	 (7b)
Number of flueless gas fire	es							0	x 40 =		0	(7c)
									-	Air	changes pe hour	r
Infiltration due to chimney	/s, flues, fans,	PSVs		(6a)) + (6b) + (7	a) + (7b) + (7c) =	80	÷ (5) =		0.65	(8)
If a pressurisation test has			ntended, p	proceed to ((17), otherw	ise continu	e from (9) t	o (16)				
Air permeability value, q50), expressed i	n cubic me	etres per l	nour per sq	uare metre	of envelope	e area				10.00	(17)
If based on air permeabilit	y value, then	(18) = [(17	') ÷ 20] + ((8), otherwi	se (18) = (1	6)					1.15	(18)
Number of sides on which	the dwelling	is sheltere	d								3	(19)
Shelter factor	-							1 -	[0.075 x (19	9)] =	0.78	(20)
Infiltration rate incorporat	ing shelter fa	ctor							(18) x (2	20) =	0.89	(21)
Infiltration rate modified f	or monthly w	ind speed:										
Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spe	ed from Table	e U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4						•	•					
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for s	helter and	wind fact	tor) (21) x (2	22a)m	÷	•				•	
1.13	1.11	1.09	0.98	0.96	0.84	0.84	0.82	0.89	0.96	1.00	1.04	(22b)
Calculate effective air char	nge rate for th	ne applicat	ole case:			-	·				-	_ `
If mechanical ventilatic	on: air change	rate throu	ıgh syster	n							N/A	(23a)
If balanced with heat re	•				ictor from T	able 4h					N/A	(23c)
d) natural ventilation o		-	-							L		
1.13	1.11	1.09	0.98	0.96	0.86	0.86	0.84	0.90	0.96	1.00	1.04	(24d)
Effective air change rate -					•							
1.13	1.11	1.09	0.98	0.96	0.86	0.86	0.84	0.90	0.96	1.00	1.04	(25)
L	· ·			•	•		•				•	



	and heat los												
Element			а	Gross rea, m²	Openings m ²	Net A,		U-value W/m ² K	A x U W		value, /m².K	Ахк, kJ/K	
Window						5.	79 x	2.68	= 15.51				(27)
External wall						62.	.74 x	2.50	= 156.85	5			(29a)
Roof						38.	.50 x	2.60	= 100.10)			(30)
Roof						16.	.20 x	1.90	= 30.78				(30)
Total area of ext	ternal eleme	ents ∑A, m²	2			123	.23						(31)
Fabric heat loss,	W/K = ∑(A	- × U)							(26	5)(30) + (3	32) =	303.24	(33)
Heat capacity Cr	m = ∑(А x к)							(28)	(30) + (32) +	(32a)(32	2e) =	N/A	(34)
Thermal mass pa	-	MP) in kJ/r	n²K							. , .		250.00	(35)
Thermal bridges	-			dix K								18.48	(36)
Total fabric heat			0 11-							(33) + (3	36) =	321.72	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec], ,
Ventilation heat	: loss calcula	ited month	ıly 0.33 x (2	•									
	46.24	45.34	44.43	39.90	39.03	34.95	34.95	34.19	36.52	39.03	40.80	42.62	(38)
Heat transfer co] (,
	367.97	367.06	366.15	361.63	360.75	356.67	356.67	355.92	358.24	360.75	362.53	364.34	1
		007.00	000120	001.00	000000				Average = Σ			361.56	(39)
Heat loss param	eter (HLP).	W/m²K (39	9)m ÷ (4)						2.1010,80 Z	(00)22)] (00)
	6.73	6.71	6.69	6.61	6.60	6.52	6.52	6.51	6.55	6.60	6.63	6.66	1
	0.75	0.71	0.05	0.01	0.00	0.52	0.52		Average = ∑		·	6.61	(40)
Number of days	in month (1	Table 1a)							/weruge = Z	(40)112)	12 -	0.01] (40)
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
	51.00	20.00	51.00	30.00	51.00	30.00	51.00	1 51.00	50.00	51.00	30.00	51.00] (40)
4. Water heati	ng energy r	equiremen	t.										
		equilement				_							
Assumed occupa	ancy, N	equiremen										1.83	(42)
Assumed occupa Annual average				Vd,average	= (25 x N) +	36						1.83 77.63] (42)] (43)
•				Vd,average Apr	= (25 x N) + May	36 Jun	Jul	Aug	Sep	Oct	Nov		-
•	hot water u Jan	sage in litro Feb	es per day Mar	Apr	May	Jun		Aug	Sep	Oct	Nov	77.63	-
Annual average	hot water u Jan	sage in litro Feb	es per day Mar	Apr	May	Jun		Aug 72.97	Sep 76.08	Oct 79.18	Nov	77.63	-
Annual average	hot water u Jan e in litres pe	sage in litro Feb r day for ea	es per day Mar ach month	Apr Vd,m = fact	May tor from Tab	Jun le 1c x (43)	-			82.29	77.63 Dec	-
Annual average	hot water u Jan e in litres pe 85.39	sage in litro Feb r day for ea 82.29	es per day ' Mar ach month 79.18	Apr Vd,m = fact 76.08	May tor from Tab	Jun le 1c x (43 69.87) 69.87	72.97		79.18	82.29	77.63 Dec 85.39] (43)
Annual average Hot water usage	hot water u Jan e in litres pe 85.39	sage in litro Feb r day for ea 82.29	es per day ' Mar ach month 79.18	Apr Vd,m = fact 76.08	May tor from Tab	Jun le 1c x (43 69.87) 69.87	72.97		79.18	82.29	77.63 Dec 85.39] (43)
Annual average Hot water usage	hot water u Jan in litres pe 85.39	sage in litre Feb r day for ea 82.29 r used = 4.1	es per day ' Mar ach month 79.18 18 x Vd,m x	Apr Vd,m = fact 76.08	May for from Tab 72.97	Jun le 1c x (43 69.87 nonth (see) 69.87 Tables 1b,	72.97 1c 1d)	76.08	79.18 ∑(44)1	82.29 12 = 112.93	77.63 Dec 85.39 931.54] (43)
Annual average Hot water usage	hot water u Jan e in litres pe 85.39 of hot wate 126.63	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75	es per day ' Mar ach month 79.18 18 x Vd,m x	Apr Vd,m = fact 76.08	May for from Tab 72.97	Jun le 1c x (43 69.87 nonth (see) 69.87 Tables 1b,	72.97 1c 1d)	76.08	79.18 Σ(44)1 103.46	82.29 12 = 112.93	77.63 Dec 85.39 931.54 122.64] (43)] (44)]
Annual average Hot water usage Energy content o	hot water u Jan e in litres pe 85.39 of hot wate 126.63	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75	es per day ' Mar ach month 79.18 18 x Vd,m x	Apr Vd,m = fact 76.08	May for from Tab 72.97	Jun le 1c x (43 69.87 nonth (see) 69.87 Tables 1b,	72.97 1c 1d)	76.08	79.18 Σ(44)1 103.46	82.29 12 = 112.93	77.63 Dec 85.39 931.54 122.64] (43)] (44)]
Annual average Hot water usage Energy content o	hot water u Jan e in litres pe 85.39 of hot wate 126.63 5 0.15 x (45) 18.99	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61	es per day ' Mar ach month 79.18 18 x Vd,m x 114.29	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95	May tor from Tab 72.97 3600 kWh/m 95.61	Jun le 1c x (43 69.87 nonth (see 82.50) 69.87 Tables 1b, 76.45	72.97 1c 1d) 87.73	76.08	79.18 Σ(44)1 103.46 Σ(45)1	82.29 12 = 112.93 12 =	77.63 Dec 85.39 931.54 122.64 1221.40] (43)] (44)] (44)] (45)
Annual average Hot water usage Energy content o Distribution loss	hot water u Jan e in litres pe 85.39 of hot wate 126.63 5 0.15 x (45) 18.99	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61	es per day ' Mar ach month 79.18 18 x Vd,m x 114.29	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95	May tor from Tab 72.97 3600 kWh/m 95.61	Jun le 1c x (43 69.87 nonth (see 82.50) 69.87 Tables 1b, 76.45	72.97 1c 1d) 87.73	76.08	79.18 Σ(44)1 103.46 Σ(45)1	82.29 12 = 112.93 12 =	77.63 Dec 85.39 931.54 122.64 1221.40] (43)] (44)] (44)] (45)
Annual average Hot water usage Energy content o Distribution loss	hot water u Jan e in litres pe 85.39 of hot wate 126.63 5 0.15 x (45) 18.99 oss calculate 0.00	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95 5) x (41)m 0.00	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00) 69.87 Tables 1b, 76.45 11.47 0.00	72.97 1c 1d) 87.73 13.16	76.08 88.77 13.32	79.18 Σ(44)1 103.46 Σ(45)1 15.52	82.29 12 = 112.93 12 = 16.94	77.63 Dec 85.39 931.54 1221.40 18.40] (43)] (44)] (44)] (45)] (46)
Annual average Hot water usage Energy content of Distribution loss Water storage lo	hot water u Jan e in litres pe 85.39 of hot wate 126.63 5 0.15 x (45) 18.99 oss calculate 0.00	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95 5) x (41)m 0.00	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00) 69.87 Tables 1b, 76.45 11.47 0.00	72.97 1c 1d) 87.73 13.16	76.08 88.77 13.32	79.18 Σ(44)1 103.46 Σ(45)1 15.52	82.29 12 = 112.93 12 = 16.94	77.63 Dec 85.39 931.54 1221.40 18.40] (43)] (44)] (44)] (45)] (46)
Annual average Hot water usage Energy content of Distribution loss Water storage lo	hot water u Jan e in litres pe 85.39 of hot wate 126.63 5 0.15 x (45) 18.99 oss calculate 0.00 tains dedica	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00 ated solar s 0.00	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00 torage or c 0.00	Apr Vd,m = fact 76.08 : nm x Tm/3 99.64 14.95 5) x (41)m 0.00 ledicated W	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00 /WHRS (56)r	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00 n x [(47) -) 69.87 Tables 1b, 76.45 11.47 0.00 Vs] ÷ (47),	72.97 1c 1d) 87.73 13.16 0.00 else (56)	76.08 88.77 13.32 0.00	79.18 Σ(44)1 103.46 Σ(45)1 15.52 0.00	82.29 12 = 112.93 12 = 16.94 0.00	77.63 Dec 85.39 931.54 1221.40 18.40 0.00] (43)] (44)] (44)] (45)] (46)] (56)
Annual average Hot water usage Energy content o Distribution loss Water storage lo If the vessel con	hot water u Jan e in litres pe 85.39 of hot wate 126.63 5 0.15 x (45) 18.99 oss calculate 0.00 tains dedica	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00 ated solar s 0.00	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00 torage or c 0.00	Apr Vd,m = fact 76.08 : nm x Tm/3 99.64 14.95 5) x (41)m 0.00 ledicated W	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00 /WHRS (56)r	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00 n x [(47) -) 69.87 Tables 1b, 76.45 11.47 0.00 Vs] ÷ (47),	72.97 1c 1d) 87.73 13.16 0.00 else (56)	76.08 88.77 13.32 0.00	79.18 Σ(44)1 103.46 Σ(45)1 15.52 0.00	82.29 12 = 112.93 12 = 16.94 0.00	77.63 Dec 85.39 931.54 1221.40 18.40 0.00] (43)] (44)] (44)] (45)] (46)] (56)] (57)
Annual average Hot water usage Energy content o Distribution loss Water storage lo If the vessel con	hot water u Jan e in litres pe 85.39 of hot wate 126.63 $30.15 \times (45)$ 18.99 oss calculate 0.00 tains dedica 0.00 oss for each 0.00	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00 ated solar s 0.00 month fro 0.00	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00 xtorage or c 0.00 m Table 3 0.00	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95 5) x (41)m 0.00 ledicated W 0.00	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00 WHRS (56)r 0.00	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00 m x [(47) - 0.00) 69.87 Tables 1b, 76.45 11.47 0.00 Vs] ÷ (47), 0.00	72.97 1c 1d) 87.73 13.16 0.00 else (56) 0.00	76.08 88.77 13.32 0.00	79.18 Σ(44)1 103.46 Σ(45)1 15.52 0.00 0.00	82.29 12 = 112.93 12 = 16.94 0.00 0.00	77.63 Dec 85.39 931.54 1221.40 1221.40 18.40 0.00 0.00] (43)] (44)] (44)] (45)] (46)] (56)
Annual average Hot water usage Energy content of Distribution loss Water storage lo If the vessel con Primary circuit lo	hot water u Jan e in litres pe 85.39 of hot wate 126.63 $30.15 \times (45)$ 18.99 oss calculate 0.00 tains dedica 0.00 oss for each 0.00	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00 ated solar s 0.00 month fro 0.00	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00 xtorage or c 0.00 m Table 3 0.00	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95 5) x (41)m 0.00 ledicated W 0.00	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00 WHRS (56)r 0.00	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00 m x [(47) - 0.00) 69.87 Tables 1b, 76.45 11.47 0.00 Vs] ÷ (47), 0.00	72.97 1c 1d) 87.73 13.16 0.00 else (56) 0.00	76.08 88.77 13.32 0.00	79.18 Σ(44)1 103.46 Σ(45)1 15.52 0.00 0.00	82.29 12 = 112.93 12 = 16.94 0.00 0.00 0.00	77.63 Dec 931.54 1221.40 1221.40 18.40 0.00 0.00] (43)] (44)] (44)] (45)] (45)] (46)] (56)] (57)] (59)
Annual average Hot water usage Energy content of Distribution loss Water storage lo If the vessel con Primary circuit lo Combi loss for e	hot water u Jan e in litres pe 85.39 of hot wate 126.63 s $0.15 \times (45)$ 18.99 oss calculate 0.00 itains dedica 0.00 oss for each 0.00 ach month 50.96	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00 ated solar s 0.00 month fro 0.00 from Table 46.03	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00 torage or c 0.00 m Table 3 0.00 3a, 3b or 3 50.96	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95 5) x (41)m 0.00 ledicated W 0.00 c 49.32	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00 /WHRS (56)r 0.00 0.00	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00 m x [(47) - 0.00 0.00 49.32) 69.87 Tables 1b, 76.45 11.47 0.00 Vs] ÷ (47), 0.00 0.00 50.96	72.97 1c 1d) 87.73 13.16 0.00 else (56) 0.00 0.00	76.08 88.77 13.32 0.00 0.00 49.32	79.18 Σ(44)1 103.46 Σ(45)1 15.52 0.00 0.00 0.00	82.29 12 = 112.93 12 = 16.94 0.00 0.00	77.63 Dec 85.39 931.54 1221.40 1221.40 18.40 0.00 0.00] (43)] (44)] (44)] (45)] (46)] (56)] (57)
Annual average Hot water usage Energy content of Distribution loss Water storage lo If the vessel con Primary circuit lo	hot water u Jan e in litres pe 85.39 of hot wate 126.63 s $0.15 \times (45)$ 18.99 oss calculate 0.00 itains dedica 0.00 oss for each 0.00 ach month 50.96	sage in litre Feb r day for ea 82.29 r used = 4.1 110.75 m 16.61 ed for each 0.00 ated solar s 0.00 month fro 0.00 from Table 46.03	es per day Mar ach month 79.18 18 x Vd,m x 114.29 17.14 month (55 0.00 torage or c 0.00 m Table 3 0.00 3a, 3b or 3 50.96	Apr Vd,m = fact 76.08 nm x Tm/3 99.64 14.95 5) x (41)m 0.00 ledicated W 0.00 c 49.32	May tor from Tab 72.97 3600 kWh/m 95.61 14.34 0.00 /WHRS (56)r 0.00 0.00	Jun le 1c x (43 69.87 nonth (see 82.50 12.38 0.00 m x [(47) - 0.00 0.00 49.32) 69.87 Tables 1b, 76.45 11.47 0.00 Vs] ÷ (47), 0.00 0.00 50.96	72.97 1c 1d) 87.73 13.16 0.00 else (56) 0.00 0.00	76.08 88.77 13.32 0.00 0.00 49.32	79.18 Σ(44)1 103.46 Σ(45)1 15.52 0.00 0.00 0.00	82.29 12 = 112.93 12 = 16.94 0.00 0.00 0.00	77.63 Dec 931.54 1221.40 1221.40 18.40 0.00 0.00] (43)] (44)] (44)] (45)] (45)] (46)] (56)] (57)] (59)

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)
Output from wat							0.00	0.00	0.00	0.00	0.00	0.00 (03)
Output nom wa							127.41	129.60	129.00	154.40	162.25	172.60
	177.59	156.78	165.25	148.95	146.56	131.82	127.41	138.69	138.09	154.42	162.25	173.60
llest seine frem		:	anth) 0.21		(45)	\ml + 0.0 ···	[(4C)	7)		∑(64)1	.12 =	1821.40 (64)
Heat gains from			-		1		1					
	54.85	48.33	50.74	45.46	44.53	39.76	38.16	41.91	41.85	47.14	49.88	53.52 (65)
5. Internal gain	s											
<u> </u>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains				ľ				. 0			-	
	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71 (66)
Lighting gains (ca		II					109.71	105.71	105.71	105.71	105.71	109.71 (00)
Lighting gains (Co							20.14	20.17	52.50	6676	77.02	
A	80.82	71.78	58.38	44.19	33.04	27.89	30.14	39.17	52.58	66.76	77.92	83.06 (67)
Appliance gains			-	1	1							/
	237.93	240.40	234.18	220.93	204.21	188.50	178.00	175.53	181.75	195.00	211.72	227.43 (68)
Cooking gains (ca	alculated in	Appendix I	., equation	L15 or L15	a), also see	Table 5						
	47.80	47.80	47.80	47.80	47.80	47.80	47.80	47.80	47.80	47.80	47.80	47.80 <mark>(69)</mark>
Pump and fan ga	ins (Table S	5a)										
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00 (70)
Losses e.g. evapo	oration (Tal	ole 5)										
	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14 (71)
Water heating g	ains (Table	5)										
	73.72	71.92	68.20	63.14	59.85	55.22	51.29	56.33	58.12	63.36	69.28	71.93 (72)
Total internal ga	ins (66)m +	+ (67)m + (6	8)m + (69)	m + (70)m ·	+ (71)m + (1	72)m						
				(
	479.83	471.47		415.63	384.47		346.80	358.40	379.82	412.49	446.28	469.80 (73)
	479.83	· · ·	448.12		1	, 358.98	346.80	358.40	379.82	412.49	446.28	469.80 (73)
6. Solar gains	479.83	· · ·			1		346.80	358.40	379.82	412.49	446.28	469.80 (73)
6. Solar gains	479.83	· · ·	448.12	415.63	384.47 Area	358.98 Sol	ar flux		g	FF		Gains
6. Solar gains	479.83	· · ·	448.12	415.63	384.47	358.98 Sol		spec	g ific data	FF specific d	lata	、 、
	479.83	· · ·	448.12 Access f Table	415.63 Factor 6d	384.47 Area m²	358.98 Sol. W	ar flux //m²	spec or T	g ific data able 6b	FF specific d or Table	lata 6c	Gains W
SouthWest	479.83	· · ·	448.12 Access f Table	415.63 Factor 6d	384.47 Area m ² 2.97	358.98 Sol. W	ar flux //m² 6.79 ×	spec or T 0.9 x	g ific data able 6b 0.85 ×	FF specific d or Table	lata 6c	Gains W 58.52 (79)
SouthWest NorthEast	479.83	· · ·	448.12 Access f Table 1.00 0.30	415.63	384.47 Area m ² 2.97 1.98	358.98 Sol. X X X 1	ar flux //m ² 6.79 x 1.28 x	spec or T 0.9 x (0 0.9 x (0	g ific data able 6b D.85 x D.85 x	FF specific d or Table 0.70 0.70	lata 6c = [Gains W 58.52 (79) 3.59 (75)
SouthWest NorthEast SouthEast		471.47	448.12 Access f Table	415.63	384.47 Area m ² 2.97	358.98 Sol. X X X 1	ar flux //m ² 6.79 x 1.28 x	spec or T 0.9 x (0 0.9 x (0	g ific data able 6b 0.85 ×	FF specific d or Table 0.70 0.70	lata 6c	Gains W 58.52 (79)
SouthWest NorthEast	tts ∑(74)m	471.47	448.12 Access f Table 1.0 0.3 0.3	415.63	384.47 Area m ² 2.97 1.98 0.84	358.98 Sol. W x 3 x 1 x 1 x 3	ar flux //m ² 6.79 x 1.28 x 6.79 x	spec or T 0.9 x (0 0.9 x (0 0.9 x (0	g ific data able 6b 0.85 x 0.85 x 0.85 x	FF specific d or Table 0.70 0.70 0.70	lata 6c = [Gains W 58.52 (79) 3.59 (75) 4.21 (77)
SouthWest NorthEast SouthEast Solar gains in wa	tts ∑(74)m 66.31	471.47 (82)m 114.15	448.12 Access f Table 1.00 0.31 0.31 159.35	415.63	384.47 Area m ² 2.97 1.98	358.98 Sol. X X X 1	ar flux //m ² 6.79 x 1.28 x	spec or T 0.9 x (0 0.9 x (0	g ific data able 6b D.85 x D.85 x	FF specific d or Table 0.70 0.70	lata 6c = [Gains W 58.52 (79) 3.59 (75)
SouthWest NorthEast SouthEast	tts ∑(74)m 66.31	471.47 (82)m 114.15	448.12 Access f Table 1.00 0.31 0.31 159.35	415.63	384.47 Area m ² 2.97 1.98 0.84	358.98 Sol. W x 3 x 1 x 1 x 3	ar flux //m ² 6.79 x 1.28 x 6.79 x	spec or T 0.9 x (0 0.9 x (0 0.9 x (0	g ific data able 6b 0.85 x 0.85 x 0.85 x	FF specific d or Table 0.70 0.70 0.70	lata 6c = [Gains W 58.52 (79) 3.59 (75) 4.21 (77)
SouthWest NorthEast SouthEast Solar gains in wa	tts ∑(74)m 66.31	471.47 (82)m 114.15	448.12 Access f Table 1.00 0.31 0.31 159.35	415.63	384.47 Area m ² 2.97 1.98 0.84	358.98 Sol. W x 3 x 1 x 1 x 3	ar flux //m ² 6.79 x 1.28 x 6.79 x	spec or T 0.9 x (0 0.9 x (0 0.9 x (0	g ific data able 6b 0.85 x 0.85 x 0.85 x	FF specific d or Table 0.70 0.70 0.70	lata 6c = [Gains W 58.52 (79) 3.59 (75) 4.21 (77)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inte	tts ∑(74)m 66.31 rnal and so 546.15	471.47 (82)m 114.15 lar (73)m + 585.62	448.12 Access f Table 1.00 0.30 0.30 159.35 (83)m 607.47	415.63	384.47 Area m ² 2.97 1.98 0.84 231.94	358.98 Sol X X X X X 3 X 3 Z32.39	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33	FF specific d or Table 0.70 0.70 0.70 127.01	lata 6c = = =	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inte 7. Mean intern	tts ∑(74)m 66.31 rnal and so 546.15 al tempera	471.47 (82)m 114.15 lar (73)m + 585.62 ture (heatin	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 ng season)	415.63 factor 6d x [0 x [0 x [202.75 618.38	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41	358.98 Sol X X X X 232.39 591.37	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33	FF specific d or Table 0.70 0.70 0.70 127.01	lata 6c = = =	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inte	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating	471.47 (82)m 114.15 lar (73)m + 585.62 ture (heating periods in	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 hg season) the living a	415.63 factor 6d 0 x [0 x [0 x [0 x [0 x [0 x [0 x] 0 x [0 x [0 x] 0 x [0 x [0 x] 0 x] 0 x [0 x] 0 x [0 x] 0 x] 0 x] 0 x [0 x] 0	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41	358.98 Sol. W X 3 X 1 X 3 232.39 591.37 (°C)	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15	FF specific d or Table 0.70 0.70 0.70 127.01	lata 6c = [] = [] = [] = [79.64 525.93	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating Jan	471.47 (82)m 114.15 lar (73)m + 585.62 ture (heating g periods in Feb	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 tg season) the living a Mar	415.63 actor 6d x [0 x [0 x [0 x [202.75 618.38 area from T Apr	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41	358.98 Sol X X X X 232.39 591.37	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33	FF specific d or Table 0.70 0.70 0.70 127.01	lata 6c = = =	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inte 7. Mean intern	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating Jan	471.47 (82)m 114.15 lar (73)m + 585.62 ture (heating g periods in Feb	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 tg season) the living a Mar	415.63 actor 6d x [0 x [0 x [0 x [202.75 618.38 area from T Apr	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41	358.98 Sol. W X 3 X 1 X 3 232.39 591.37 (°C)	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15	FF specific d or Table 0.70 0.70 0.70 127.01	lata 6c = [] = [] = [] = [79.64 525.93	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du Utilisation factor	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating Jan for gains fo 0.98	471.47 471.47 471.47 47 47 47 47 47 47 47 47 47 47 47 47 4	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 (83)m 607.47 the living a Mar a n1,m (se 0.98	415.63 actor 6d x [0 x [0 x [0 x [202.75 618.38 area from T Apr e Table 9a) 0.97	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41 616.41 Gable 9, Th1 May 0.95	358.98 Sol. W X 3 X 1 X 3 232.39 591.37 (°C)	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15	FF specific d or Table 0.70 0.70 0.70 127.01	lata 6c = [] = [] = [] = [79.64 525.93	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating Jan for gains fo 0.98	471.47 471.47 471.47 47 47 47 47 47 47 47 47 47 47 47 47 4	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 (83)m 607.47 the living a Mar a n1,m (se 0.98	415.63 actor 6d x [0 x [0 x [0 x [202.75 618.38 area from T Apr e Table 9a) 0.97	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41 616.41 Gable 9, Th1 May 0.95	358.98 Sol. W X 3 X 1 X 3 232.39 591.37 (°C) Jun	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96 Jul	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46 Aug	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15 Sep	FF specific d or Table 0.70 0.70 0.70 127.01 539.50 Oct	lata 6c = [] = [] = [] = [79.64 525.93	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85) Dec
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du Utilisation factor	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating Jan for gains fo 0.98	471.47 471.47 471.47 47 47 47 47 47 47 47 47 47 47 47 47 4	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 (83)m 607.47 the living a Mar a n1,m (se 0.98	415.63 actor 6d x [0 x [0 x [0 x [202.75 618.38 area from T Apr e Table 9a) 0.97	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41 616.41 Gable 9, Th1 May 0.95	358.98 Sol. W X 3 X 1 X 3 232.39 591.37 (°C) Jun	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96 Jul	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46 Aug	g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15 Sep	FF specific d or Table 0.70 0.70 0.70 127.01 539.50 Oct	lata 6c = [] = [] = [] = [79.64 525.93	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85) Dec
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du Utilisation factor	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating Jan for gains fo 0.98 emp of living 16.33	471.47 471.47	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 (83)m 607.47 the living a Mar an 1,m (se 0.98 teps 3 to 7 17.06	415.63 actor 6d x [0 x [0 x [0 x [202.75 618.38 area from T Apr e Table 9a) 0.97 in Table 9c 17.81	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41 616.41 616.41 0.95 c) 18.66	358.98 Sol X 3 X 1 X 3 232.39 591.37 (°C) Jun 0.92 19.52	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96 Jul 0.88	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46 Aug 0.89	<pre>g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15 Sep 0.94</pre>	FF specific d or Table 0.70 0.70 127.01 539.50 Oct 0.97	lata 6c = [] = [] = [] = [79.64 525.93 525.93	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85) Dec (86)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du Utilisation factor Mean internal te	tts ∑(74)m 66.31 rnal and so 546.15 al tempera ring heating Jan for gains fo 0.98 emp of living 16.33	471.47 471.47	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 (83)m 607.47 the living a Mar an 1,m (se 0.98 teps 3 to 7 17.06	415.63 actor 6d x [0 x [0 x [0 x [202.75 618.38 area from T Apr e Table 9a) 0.97 in Table 9c 17.81	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41 616.41 616.41 0.95 c) 18.66	358.98 Sol X 3 X 1 X 3 232.39 591.37 (°C) Jun 0.92 19.52	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96 Jul 0.88	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46 Aug 0.89	<pre>g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15 Sep 0.94</pre>	FF specific d or Table 0.70 0.70 127.01 539.50 Oct 0.97	lata 6c = [] = [] = [] = [79.64 525.93 525.93	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85) Dec (86)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du Utilisation factor Mean internal te	tts $\Sigma(74)$ m 66.31 rnal and so 546.15 al tempera ring heating Jan for gains fo 0.98 emp of living 16.33 ring heating 18.00	471.47 471.47	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 (83)m 70 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 70 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m	415.63 actor 6d 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 618.38 area from T Apr e Table 9a) 0.97 in Table 9c 17.81 dwelling fr 18.00	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41 616.41 616.41 0.95 c) 18.66 rom Table 9	358.98 Sol X X 3 X 3 X 3 X 3 X 3 X 3 232.39 591.37 (°C) Jun 0.92 (°C) Jun 0.92	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96 Jul 0.88 20.09	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46 Aug 0.89 20.03	<pre>g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15 Sep 0.94 19.34</pre>	FF specific d or Table 0.70 0.70 127.01 539.50 Oct 0.97 18.27	lata 6c = [= [79.64 525.93 [Nov 0.98 17.19	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85) Dec 0.99 (86) 16.30 (87)
SouthWest NorthEast SouthEast Solar gains in wa Total gains - inter 7. Mean intern Temperature du Utilisation factor Mean internal te Temperature du	tts $\Sigma(74)$ m 66.31 rnal and so 546.15 al tempera ring heating Jan for gains fo 0.98 emp of living 16.33 ring heating 18.00	471.47 471.47	448.12 Access f Table 1.0 0.3 0.3 159.35 (83)m 607.47 (83)m 70 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 70 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m 607.47 (83)m	415.63 actor 6d 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 618.38 area from T Apr e Table 9a) 0.97 in Table 9c 17.81 dwelling fr 18.00	384.47 Area m ² 2.97 1.98 0.84 231.94 616.41 616.41 616.41 0.95 c) 18.66 rom Table 9	358.98 Sol X X X 3 X 1 X 3 Z32.39 591.37 (°C) Jun 0.92 19.52 0, Th2(°C)	ar flux //m ² 6.79 x 1.28 x 6.79 x 223.16 569.96 Jul 0.88 20.09	spec or T 0.9 x (0 0.9 x (0 0.9 x (0 201.06 559.46 Aug 0.89 20.03	<pre>g ific data able 6b 0.85 x 0.85 x 0.72 x 174.33 554.15 Sep 0.94 19.34</pre>	FF specific d or Table 0.70 0.70 127.01 539.50 Oct 0.97 18.27	lata 6c = [= [79.64 525.93 [Nov 0.98 17.19	Gains W 58.52 (79) 3.59 (75) 4.21 (77) 56.61 (83) 526.41 (84) 21.00 (85) Dec 0.99 (86) 16.30 (87)

SAP version 9.92

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 16.18 14.24 14.46 14.97 15.72 16.56 17.38 17.86 17.82 17.22 15.10 14.21 (90)Living area fraction Living area \div (4) = 0.48 (91) Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2 15.23 15.45 15.96 16.72 17.56 18.40 18.92 18.87 18.23 17.17 16.10 15.21 (92) Apply adjustment to the mean internal temperature from Table 4e where appropriate 15.08 15.30 15.81 16.57 17.41 18.25 18.77 18.72 18.08 17.02 15.95 15.06 (93) 8. Space heating requirement May Jan Feb Mar Apr Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, nm 0.96 0.96 0.91 0.84 0.72 0.75 0.87 0.93 0.96 0.97 0.97 0.94 (94)Useful gains, nmGm, W (94)m x (84)m 529.51 564.63 580.23 580.24 558.75 496.45 412.02 417.26 480.96 504.16 505.37 511.39 (95)Monthly average external temperature from Table U1 16.40 4.30 4.90 6.50 8.90 11.70 14.60 16.60 14.10 10.60 7.10 4.20 (96)Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 3968.35 3818.61 3409.64 2772.28 2059.26 1301.66 774.15 825.22 1425.58 2316.78 3206.75 3954.99 (97) Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m 0.00 0.00 2558.50 2186.67 2105.08 1578.27 1116.37 0.00 0.00 1348.59 1944.99 2562.04 ∑(98)1...5, 10...12 = 15400.52 (98) Space heating requirement kWh/m²/year (98) ÷ (4) 281.55 (99) 9a. Energy requirements - individual heating systems including micro-CHP Space heating Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)1 - (201) = 1.00 (202) Fraction of space heat from main system(s) Fraction of space heat from main system 2 0.00 (202)1.00 Fraction of total space heat from main system 1 (202) x [1- (203)] = (204) Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)84.00 Efficiency of main system 1 (%) (206)Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Space heating fuel (main system 1), kWh/month 3045.83 2603.18 2506.05 0.00 0.00 1605.46 2315.47 3050.05 1878.90 1329.02 0.00 0.00 ∑(211)1...5, 10...12 = 18333.95 (211)Water heating Efficiency of water heater 83.35 83.33 83.27 83.14 82.85 75.00 75.00 75.00 75.00 82.98 83.23 83.37 (217) Water heating fuel, kWh/month 213.07 188.14 198.44 179.16 176.91 175.75 169.88 184.91 184.12 194.94 186.10 208.24 (219) ∑(219a)1...12 = 2259.65 Annual totals Space heating fuel - main system 1 18333.95 Water heating fuel 2259.65 Electricity for pumps, fans and electric keep-hot (Table 4f) central heating pump or water pump within warm air heating unit 30.00 (230c) boiler flue fan 45.00 (230e) Total electricity for the above, kWh/year 75.00 (231)

Total delivered energy for all uses

10a. Fuel costs - individual heating systems including micro-CHP

(232) (238)

570.90

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	18333.95	x	3.48	x 0.01 =	638.02	(240)
Water heating	2259.65	x	3.48	x 0.01 =	78.64	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	570.90	x	13.19	x 0.01 =	75.30	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	921.85	(255)
11a. SAP rating - individual heating systems inc	cluding micro-CHP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					3.88	(257)
SAP value					45.70	
SAP rating (section 13)					46	(258)
SAP band					E	
12a. CO ₂ emissions - individual heating systems	s including micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	18333.95	x	0.22	=	3960.13	(261)
Water heating	2259.65	x	0.22	=	488.09	(264)
Space and water heating			(261) + (262) + (263) + (264) =	4448.22	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	570.90	x	0.52	=	296.30	(268)
Total CO ₂ , kg/year				(265)(271) =	4783.44	(272)

	Energy kWh/year		Emission factor kg CO ₂ /kWh	Emissions kg CO₂/year	
Space heating - main system 1	18333.95	x	0.22 =	3960.13	(261)
Water heating	2259.65	x	0.22 =	488.09	(264)
Space and water heating			(261) + (262) + (263) + (264)	= 4448.22	(265)
Pumps and fans	75.00	x	0.52 =	38.93	(267)
Electricity for lighting	570.90	x	0.52 =	296.30	(268)
Total CO ₂ , kg/year			(265)(271)	= 4783.44	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4)	= 87.45	(273)
El value				40.30]
El rating (section 14)				40	(274)
El band				E]

13a. Primary energy - individual heating systems including micro-CHP

		Energy	Primary factor			Primary Energy	
		kWh/year				kWh/year	
Space heating - main system 1		18333.95	x	1.22	=	22367.42	(261)
Water heating		2259.65	x	1.22	=	2756.78	(264)
Space and water heating				(261) + (262) +	(263) + (264) =	25124.19	(265)
Pumps and fans		75.00	x	3.07	=	230.25	(267)
Electricity for lighting		570.90	x	3.07	=	1752.67	(268)
Primary energy kWh/year						27107.11	(272)
Dwelling primary energy rate kWh/m2	/year					495.56	(273)



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Andrew	Alford					As	sessor num	ber	1003		
Client							Las	at modified		01/06	/2016	
Address	179-181 Hig	gh Street,	Hamptoi	n Hill, TW12	2 1NW							
1. Overall dwelling dimen	sions											
				ļ	Area (m²)			age storey ight (m)		Vo	lume (m³)	
Lowest occupied					54.70	<mark>(1a)</mark> x		2.26	(2a) =		123.62	(3a)
Total floor area	(1a) +	(1b) + (1c) + (1d)	(1n) =	54.70	(4)						
Dwelling volume							(3a)	+ (3b) + (3e	c) + (3d)(3	n) =	123.62	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								2	x 40 =		80	(6a)
Number of open flues								0	x 20 =		0	(6b)
Number of intermittent far	ıs							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fire	S							0	x 40 =		0	(7c)
										Air	changes pe hour	r
Infiltration due to chimney	s, flues, fans, F	SVs		(6a) + (6b) + (7	'a) + (7b) + (7c) =	80	÷ (5) =		0.65	(8)
If a pressurisation test has			ntended, p					o (16)				
Air permeability value, q50								. ,			10.00	(17)
If based on air permeability											1.15	(18)
Number of sides on which				- //							3	(19)
Shelter factor								1 -	[0.075 x (19	9)] =	0.78	(20)
Infiltration rate incorporati	ng shelter fact	or							(18) x (2		0.89	(21)
Infiltration rate modified for									(10) / (1	,	0.00	
Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee										-		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4				1								/
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a						0.55	0.55	1.00	1.00	1.15	1.10	_ (220)
1.13	1.11	1.09	0.98	0.96	0.84	0.84	0.82	0.89	0.96	1.00	1.04	(22b)
Calculate effective air chan	I I I			0.50	0.04	0.04	0.02	0.05	0.50	1.00	1.04	
If mechanical ventilation	-			n							N/A	(23a)
If balanced with heat re	-				actor from ⁻	Table 4h					N/A	(23a)
d) natural ventilation or	-	-	-							L		
1.13	1.11	1.09	0.98	0.96	0.86	0.86	0.84	0.90	0.96	1.00	1.04	(24d)
Effective air change rate - e					0.00	0.00	0.04	0.90	0.90	1.00	1.04	_ (240)
1.13	1.11	1.09	0.98	0.96	0.86	0.86	0.84	0.90	0.96	1.00	1.04	(25)
1.15	1.11	1.03	0.50	0.90	0.80	0.00	0.04	0.90	0.90	1.00	1.04	(23)



3. Heat losses	and heat los	ss paramet	er										
Element			а	Gross rea, m²	Openings m ²		area m²	U-value W/m²K	A x U V		/alue, /m².K	Ахк, kJ/K	
Window						5.	79 x	1.50	= 8.71				(27)
External wall						62	.74 x	0.28	= 17.5	7			(29a)
Roof						38	.50 x	0.11	= 4.24	+			(30)
Roof						16	.20 x	0.15	= 2.43				(30)
Total area of ex	ternal eleme	ents ∑A, m²				123	3.23	, ,					(31)
Fabric heat loss,	, W/K = Σ(A	- × U)							(2	6)(30) + (32) =	32.94	(33)
Heat capacity C	m = ∑(А x к)							(28)	.(30) + (32)	+ (32a)(3	2e) =	N/A	(34)
Thermal mass p	arameter (T	MP) in kJ/n	n²K									250.00	(35)
Thermal bridges	s: Σ(L x Ψ) ca	lculated us	sing Appen	dix K								6.82	(36)
Total fabric hea	t loss									(33) + (36) =	39.76	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	t loss calcula	ted month	ly 0.33 x (2	25)m x (5)									
	46.24	45.34	44.43	39.90	39.03	34.95	34.95	34.19	36.52	39.03	40.80	42.62	(38)
Heat transfer co	efficient, W	/K (37)m +	(38)m		•			•				•	
	86.00	85.10	84.19	79.67	78.79	74.71	74.71	73.95	76.28	78.79	80.56	82.38	7
				-					Average =	∑(39)112,	/12 =	79.59	(39)
Heat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.57	1.56	1.54	1.46	1.44	1.37	1.37	1.35	1.39	1.44	1.47	1.51	7
									Average =	∑(40)112,	/12 =	1.46	(40)
Number of days	in month (1	able 1a)											
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heati		equiremen	t									4.00	
Assumed occup					(0							1.83	(42)
Annual average		-		-				•	6	0.1		77.63	(43)
List water wear	Jan	Feb	Mar	Apr	May		Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage	-	-						72.07	76.00	70.10	02.20	05.20	٦
	85.39	82.29	79.18	76.08	72.97	69.87	69.87	72.97	76.08	79.18	82.29	85.39	
Enorgy contont	of hot wata	rucod = 4.1	8 x V/d m y	nm v Tm/3		onth (coo	Tables 1b	1c 1d)		∑(44)1	.12 =	931.54	(44)
Energy content							1		00 77	102.46	112.02	122.64	٦
	126.63	110.75	114.29	99.64	95.61	82.50	76.45	87.73	88.77	103.46	112.93	122.64	
Distribution loss	$-0.15 \times (15)$	m								∑(45)1	.12 =	1221.40	(45)
Distribution loss			1714	14.95	14.24	12.20	11 47	12.16	12.22	15.52	16.04	18.40	
Water storage l	18.99	16.61	17.14		14.34	12.38	11.47	13.16	13.32	15.52	16.94	18.40	(46)
water storage i			0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
If the vessel con		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel con					 				0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit I													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for e	r			1	50.00	40.0-				50.00		50.55	
Tatal best as	50.96	46.03	50.96	49.32	50.96	49.32	50.96	50.96	49.32	50.96	49.32	50.96	(61)
Total heat requi		_		T				1		154.40	100.05	170.00	
Solar DHW inpu	177.59	156.78	165.25	148.95	146.56	131.82	127.41	138.69	138.09	154.42	162.25	173.60	(62)

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.0	0	0.00	(63)
Flue gas heat red					0.00	0.00	0.00	0.00	0.00		0.00	0.0	0	0.00] (03)
	-21.27	-18.61	-18.86	-16.24	-14.28	-10.93	-10.40	-11.5	5 -11.5	7	-16.46	-18.	51	-20.75	(63)
Output from wa		1					-10.40		5 -11.5	<u> </u>	-10.40	-10.	51	-20.75] (03)
output nom wa	156.32	138.17	146.38	132.72	132.29	120.89	117.01	127.1	4 126.5	2	137.95	143	74	152.85	1
	130.32	138.17	140.58	152.72	132.29	120.89	117.01	127.1	14 120.5	2	<u>Σ(64)1</u>	г		132.85] (64)
Heat gains from	water heat	ing (k)//h/n	aonth = 0.2	5 ~ [0 85 ~	(15)m + (61)m] ± 0.8 v	((46)m +	(57)m +	(50)ml		2(04)1	.12 – լ		1031.97] (04)
fieat gains from	54.85	48.33	50.74	45.46	44.53	39.76	38.16	41.9			47.14	49.	00	53.52	(65)
	54.65	40.55	50.74	45.40	44.55	59.70	56.10	41.9	1 41.03	,	47.14	49.	00	55.52] (05)
5. Internal gain	S														
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	s Sep		Oct	No	v	Dec	
Metabolic gains	(Table 5)														
	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.7	1 109.7	1	109.71	109	.71	109.71	(66)
Lighting gains (ca	alculated in	Appendix	L, equation	L9 or L9a),	also see Ta	ble 5									-
	40.41	35.89	29.19	22.10	16.52	13.95	15.07	19.5	9 26.29		33.38	38.	96	41.53	(67)
Appliance gains	(calculated	in Appendi	x L, equatio	on L13 or L	L3a), also se	ee Table 5		-							1
	237.93	240.40	234.18	220.93	204.21	188.50	178.00	175.5	53 181.7	5	195.00	211	.72	227.43	(68)
Cooking gains (c	alculated in	Appendix	L, equation	L15 or L15	a), also see	Table 5		-1						1]
	47.80	47.80	47.80	47.80	47.80	47.80	47.80	47.8	0 47.80)	47.80	47.	80	47.80	(69)
Pump and fan ga	ains (Table !	5a)	1	1	1									1], ,
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00		3.00	3.0	00	3.00	(70)
Losses e.g. evap	oration (Tal	ble 5)	1	1								1		1], ,
	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.1	4 -73.14	1	-73.14	-73.	14	-73.14	(71)
Water heating g			_] ()
00	73.72	71.92	68.20	63.14	59.85	55.22	51.29	56.3	3 58.12		63.36	69.	28	71.93	(72)
Total internal ga								1				1		1] (. –)
	439.42	435.58	418.93	393.54	367.95	, 345.04	331.73	338.8	32 353.5	3	379.11	407	.32	428.26	(73)
			.10.00		007.00	0.010.1	1 001110				0/0/11] (, 0)
6. Solar gains															
			Access f		Area		ar flux		g		FF			Gains	
			Table	e 6d	m²	V	V/m²		pecific data or Table 6b		specific or Table			W	
SouthWest			1.0	0 x [2.97		6.79	x 0.9 x 🗌	0.85	1.	0.70		= [58.52	(79)
] x] v	г				-
NorthEast			0.3		1.98			x 0.9 x	0.85] X]	0.70		-	3.59	(75) (77)
SouthEast			0.3	0 x	0.84	x 3	6.79	x 0.9 x 🗋	0.72	x	0.70		= [4.21	(77)

Solar gains in watts ∑(74)m...(82)m

66.31 114.15

159.35

Total gains - inte	rnal and so	lar (73)m +	(83)m										
	505.74	549.73	578.28	596.28	599.89	577.43	554.89	539.88	527.86	506.12	486.97	484.87	(84)

202.75 231.94 232.39 223.16 201.06 174.33 127.01

7. Mean internal temperature (heating season)													
Temperature during heating periods in the living area from Table 9, Th1(°C)												21.00	(85)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains f	or living are	ea n1,m (se	e Table 9a)									
	0.99	0.98	0.97	0.94	0.88	0.73	0.57	0.60	0.81	0.95	0.98	0.99	(86)
Mean internal te	mp of livin	g area T1 (s	steps 3 to 7	in Table 9c	:)								
	19.51	19.67	19.94	20.35	20.67	20.91	20.98	20.97	20.84	20.44	19.96	19.54	(87)
Temperature du	Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)												
	19.63	19.65	19.66	19.72	19.73	19.79	19.79	19.80	19.77	19.73	19.71	19.68	(88)

79.64

56.61 (83)

	gains for re		- 0 /										
(0.99 ().98	0.96	0.92	0.83	0.63	0.42	0.46	0.72	0.92	0.97	0.99	(89)
Mean internal tempe	erature in t	he rest o	of dwelling	g T2 (follov	v steps 3 to	7 in Table 9	e)						
1	18.33 1	8.50	18.78	19.21	19.51	19.75	19.78	19.79	19.68	19.32	18.83	18.40	(90)
Living area fraction									Li	ving area ÷	(4) =	0.48	(91)
Mean internal tempe	erature for	the who	ole dwellin	g fLA x T1	+(1 - fLA) x	Т2							
1	18.89 1	9.06	19.33	19.75	20.06	20.30	20.35	20.35	20.23	19.85	19.37	18.94	(92)
Apply adjustment to	the mean i	nternal	temperati	ure from T	able 4e whe	ere appropr	iate						
1	18.89 1	9.06	19.33	19.75	20.06	20.30	20.35	20.35	20.23	19.85	19.37	18.94	(93)
8. Space heating re		-								-			
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for						1					1		٦
		0.98	0.96	0.92	0.84	0.67	0.49	0.52	0.76	0.92	0.97	0.99	(94)
Useful gains, ηmGm,					- i	1					1		-
		36.26	555.32	550.41	506.31	389.37	273.13	283.10	401.19	467.05	473.46	477.89	(95)
Monthly average ext	ternal temp	erature	from Tabl	e U1								-	-
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for me	ean internal	l temper	ature, Lm	, W [(39)n	n x [(93)m -	(96)m]				1		-	_
		04.82	1080.27	864.58	658.69	425.77	280.22	292.31	467.83	729.08	988.28	1214.47	(97)
Space heating requir	rement, kW	'h/mont	h 0.024 x	[(97)m - (9	95)m] x (41)	m						- .	_
56	63.47 44	49.27	390.56	226.20	113.37	0.00	0.00	0.00	0.00	194.95	370.68	548.01	
									Σ(9	8)15, 10		2856.51	(98)
Space heating requir	rement kWł	n/m²/ye	ar							(98)	÷ (4)	52.22	(99)
9a. Energy requirer	ments - indi	ividual h	neating sys	stems incl	uding micro	o-CHP							
9a. Energy requirer	ments - ind	ividual h	neating sys	stems incl	uding micro	D-CHP							
9a. Energy requirer Space heating Fraction of space heat												0.00	(201)
Space heating Fraction of space hea	at from sec	ondary/	suppleme							1 - (2)	01) =] (201)] (202)
Space heating Fraction of space heat Fraction of space heat	at from sec at from mai	ondary/ in syster	suppleme n(s)							1 - (2	01) =	1.00	(202)
Space heating Fraction of space hea Fraction of space hea Fraction of space hea	at from sec at from mai at from mai	ondary/ in syster in syster	suppleme n(s) n 2						(2(1.00 0.00] (202)] (202)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space	at from sec at from mai at from mai ce heat fror	ondary/ in syster in syster m main s	suppleme n(s) n 2 system 1						(20	02) x [1- (20)3)] = [1.00 0.00 1.00	(202) (202) (204)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space	at from sec at from mai at from mai ce heat fror ce heat fror	ondary/ in syster in syster m main s	suppleme n(s) n 2 system 1						(20)3)] = [1.00 0.00 1.00 0.00	(202) (202) (204) (205)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy	at from sec at from mai at from mai ce heat fror ce heat fror vstem 1 (%)	ondary/ in syster in syster m main s	suppleme n(s) n 2 system 1	ntary syste	em (table 11		Jul	Aug		02) x [1- (20	03)] = 03) =	1.00 0.00 1.00	(202) (202) (204)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy	at from sec at from mai at from mai ce heat fror ce heat fror vstem 1 (%) Jan	ondary/ in syster in syster n main s n main s Feb	suppleme n(s) n 2 system 1 system 2 Mar			1)	Jul	Aug	(20 Sep	02) x [1- (20 (202) x (2)3)] = [1.00 0.00 1.00 0.00 90.00	(202) (202) (204) (205)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy	at from sec at from mai at from mai ce heat fror ce heat fror ystem 1 (%) Jan main systen	ondary/ in syster in syster m main s m main s Feb n 1), kW	suppleme n(s) n 2 system 1 system 2 Mar h/month	ntary syste Apr	em (table 11 May	1)	Jul 0.00	Aug	Sep	02) x [1- (20 (202) x (20 Oct	03)] = [03) = [Nov	1.00 0.00 1.00 0.00 90.00 Dec	(202) (202) (204) (205)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy	at from sec at from mai at from mai ce heat fror ce heat fror ystem 1 (%) Jan main systen	ondary/ in syster in syster n main s n main s Feb	suppleme n(s) n 2 system 1 system 2 Mar	ntary syste	em (table 11	L) Jun		_	Sep 0.00	02) × [1- (20 (202) × (2 Oct 216.61	03)] = 03) = Nov 411.86	1.00 0.00 1.00 90.00 90.00 Dec 608.90	(202) (202) (204) (205) (206)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r	at from sec at from mai at from mai ce heat fror ce heat fror ystem 1 (%) Jan main systen	ondary/ in syster in syster m main s m main s Feb n 1), kW	suppleme n(s) n 2 system 1 system 2 Mar h/month	ntary syste Apr	em (table 11 May	L) Jun		_	Sep 0.00	02) x [1- (20 (202) x (20 Oct	03)] = 03) = Nov 411.86	1.00 0.00 1.00 0.00 90.00 Dec	(202) (202) (204) (205)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r	at from sec at from main at from main ce heat from ce heat from vstem 1 (%) Jan main system 26.08 49	ondary/ in syster in syster m main s m main s Feb n 1), kW	suppleme n(s) n 2 system 1 system 2 Mar h/month	ntary syste Apr	em (table 11 May	L) Jun		_	Sep 0.00	02) × [1- (20 (202) × (2 Oct 216.61	03)] = 03) = Nov 411.86	1.00 0.00 1.00 90.00 90.00 Dec 608.90	(202) (202) (204) (205) (206)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r Water heating Efficiency of water h	at from sec at from main at from main ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce hea	ondary/ in syster in syster n main s n main s Feb n 1), kW 99.19	suppleme n(s) n 2 system 1 system 2 Mar h/month 433.96	Apr 251.34	em (table 11 May	L) Jun 0.00	0.00	0.00	Sep 0.00 Σ(21	02) x [1- (20 (202) x (2) Oct 216.61 1)15, 10	03)] = 03) = Nov 411.86 .12 =	1.00 0.00 1.00 0.00 90.00 Dec 608.90 3173.90	(202) (202) (204) (205) (206) (206)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r 62 Water heating Efficiency of water h	at from sec at from mains at from mains ce heat from ce heat from vstem 1 (%) Jan main system 26.08 49 heater 37.60 8	ondary/ in syster in syster m main s m main s Feb n 1), kW 29.19	suppleme n(s) n 2 system 1 system 2 Mar h/month	ntary syste Apr	em (table 11 May	L) Jun		_	Sep 0.00	02) × [1- (20 (202) × (2 Oct 216.61	03)] = 03) = Nov 411.86	1.00 0.00 1.00 90.00 90.00 Dec 608.90	(202) (202) (204) (205) (206)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r 62 Water heating Efficiency of water h 8 Water heating fuel, l	at from sec at from main at from main ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce hea	ondary/ in syster in syster n main s n main s Feb n 1), kW 99.19	suppleme n(s) n 2 system 1 system 2 Mar h/month 433.96	Apr 251.34 85.98	em (table 11 May 125.97 84.26	1) Jun 0.00 79.90	0.00 79.90	0.00	Sep 0.00 Σ(21 79.90	02) x [1- (20 (202) x (2) Oct 216.61 1)15, 10 85.52	03)] = 03) = Nov 411.86 .12 = 86.93	1.00 0.00 1.00 0.00 90.00 Dec 608.90 3173.90 87.59	(202) (202) (204) (205) (206) (206)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r 62 Water heating Efficiency of water h 8 Water heating fuel, l	at from sec at from main at from main ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce heat from ce hea	ondary/ in syster in syster m main s m main s Feb n 1), kW 29.19	suppleme n(s) n 2 system 1 system 2 Mar h/month 433.96	Apr 251.34	em (table 11 May	L) Jun 0.00	0.00	0.00	Sep 0.00 Σ(21	02) x [1- (20 (202) x (2) Oct 216.61 1)15, 10 85.52 161.31)3)] = ()3)] = ()3) = ()	1.00 0.00 1.00 0.00 90.00 Dec 608.90 3173.90 87.59 174.51	(202) (202) (204) (205) (206) (206) (211)
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Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r 62 Water heating Efficiency of water h 8 Water heating fuel, H 13 Annual totals Space heating fuel - 1	at from sec at from mai at from mai ce heat fror ce heat fror stem 1 (%) Jan 26.08 49 heater 37.60 8 kWh/month 78.46 15	ondary/ in syster in syster n main s m main s Feb n 1), kW 99.19	suppleme n(s) n 2 system 1 system 2 Mar h/month 433.96	Apr 251.34 85.98	em (table 11 May 125.97 84.26	1) Jun 0.00 79.90	0.00 79.90	0.00	Sep 0.00 Σ(21 79.90	02) x [1- (20 (202) x (2) Oct 216.61 1)15, 10 85.52 161.31)3)] = [] 03) = [] Nov 411.86 .12 = [] 86.93 165.35 .12 = []	1.00 0.00 1.00 0.00 90.00 Dec 608.90 3173.90 1932.52 3173.90	(202) (202) (204) (205) (206) (206) (211)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r 62 Water heating Efficiency of water h 8 Water heating fuel, H 12 Annual totals Space heating fuel - Water heating fuel	at from sec at from mai at from mai ce heat fror ce heat fror stem 1 (%) Jan main system 26.08 49 heater 37.60 8 kWh/month 78.46 15 main system	ondary/ in syster n main s m main s Feb n 1), kW 99.19	suppleme n(s) n 2 system 1 system 2 Mar h/month 433.96 87.00 168.25	Apr 251.34 85.98 154.35	em (table 11 May 125.97 84.26	1) Jun 0.00 79.90	0.00 79.90	0.00	Sep 0.00 Σ(21 79.90	02) x [1- (20 (202) x (2) Oct 216.61 1)15, 10 85.52 161.31)3)] = [] 03) = [] Nov 411.86 .12 = [] 86.93 165.35 .12 = []	1.00 0.00 1.00 90.00 Dec 608.90 3173.90 87.59 174.51 1932.52	(202) (202) (204) (205) (206) (206) (211)
Space heating Fraction of space heat Fraction of space heat Fraction of space heat Fraction of total space Fraction of total space Efficiency of main sy Space heating fuel (r 62 Water heating Efficiency of water h 8 Water heating fuel, H 13 Annual totals Space heating fuel - 1	at from sec at from main at from main ce heat from vstem 1 (%) Jan 26.08 49 meater 37.60 8 kWh/month 78.46 19 main system 78.46 19 main system	ondary/ in syster n main s n main s Feb n 1), kW 29.19 7.40 1 58.08 n	suppleme n(s) n 2 system 1 system 2 Mar h/month 433.96 87.00 168.25	Apr 251.34 85.98 154.35	em (table 11 May 125.97 84.26 156.99	1) Jun 0.00 79.90	0.00 79.90	0.00	Sep 0.00 Σ(21 79.90	02) x [1- (20 (202) x (2) Oct 216.61 1)15, 10 85.52 161.31)3)] = [] 03) = [] Nov 411.86 .12 = [] 86.93 165.35 .12 = []	1.00 0.00 1.00 0.00 90.00 Dec 608.90 3173.90 1932.52 3173.90) (202) (202) (204) (205) (206) (206) (211)

boiler flue fan			45.00			(230e)
Total electricity for the above, kWh/year					75.00	(231)
Electricity for lighting (Appendix L)					285.45	(232)
Total delivered energy for all uses		(211	1)(221) + (231) + (2	232)(237b) =	5466.88	(238)
10a. Fuel costs - individual heating systems including micro	o-CHP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3173.90	x	3.48	x 0.01 =	110.45	(240)
Water heating	1932.52	x	3.48	x 0.01 =	67.25	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	285.45	x	13.19	x 0.01 =	37.65	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	345.25	(255)
11a. SAP rating - individual heating systems including micr	o-CHP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.45	(257)
SAP value					79.71]
SAP rating (section 13)					80	(258)
SAP band					C]
12a. CO ₂ emissions - individual heating systems including i	micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	3173.90	x	0.22	=	685.56	(261)

1932.52

75.00

285.45

х

х

х

0.22

0.52

0.52

=

=

=

(265)...(271) =

(272) ÷ (4) =

(261) + (262) + (263) + (264) =

417.43

1102.99

38.93

148.15

1290.06

23.58

82.66

83

В

(264)

(265)

(267)

(268)

(272)

(273)

(274)

13a. Primary	y energy - individua	al heating syste	ms includin	g micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	,
Space heating - main system 1	3173.90	x	1.22	=	3872.16	(261)
Water heating	1932.52	x	1.22	=	2357.68	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	6229.84	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	285.45	x	3.07	=	876.33	(268)
Primary energy kWh/year					7336.43	(272)
Dwelling primary energy rate kWh/m2/year					134.12	(273)

Water heating

Pumps and fans

Space and water heating

Electricity for lighting

Dwelling CO₂ emission rate

Total CO₂, kg/year

El rating (section 14)

EI value

EI band



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Andre	ew Alford					As	sessor num	ber	1003		
Client							La	st modified		25/05	/2016	
Address	179-181	High Street	, Hampto	n Hill, TW12	2 1NW							
1. Overall dwelling dime	nsions											
				A	Area (m²)			age storey ight (m)		Vo	olume (m³)	
Lowest occupied					54.70](1a) x		2.26	(2a) =		123.62	(3a)
Total floor area	(1a)	+ (1b) + (1e	c) + (1d)	(1n) =	54.70	(4)						
Dwelling volume							(3a)	+ (3b) + (3c) + (3d)(3	3n) =	123.62] (5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								2	x 40 =	-	80	(6a)
Number of open flues								0	x 20 =	- [0	(6b)
Number of intermittent fa	ins							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fire	es							0	x 40 =		0	(7c)
Ū.										Air	changes pe	•
				10-1) . (Ch) . (7	-) . (71-) . (7 ->		. (5)		hour	
Infiltration due to chimner If a pressurisation test has			ntandad r		(17) + (6b) + (7)			80	÷ (5) =		0.65	(8)
								0 (10)			10.00	1
Air permeability value, q5			etres per r		uare metre	or envelope	e area				10.00	
	سمماتك متناميني	(10) [/1-	1 . 201 . /	(0) at la a musi	(a. (10) (1						1 1 5	(17)
If based on air permeabilit				(8), otherwi	ise (18) = (1						1.15] (18)
Number of sides on which				(8), otherwi	ise (18) = (1				0.075 (4		3] (18)] (19)
Number of sides on which Shelter factor	the dwelling	g is sheltere		(8), otherwi	se (18) = (1			1 -	0.075 x (1		3 0.78] (18)] (19)] (20)
Number of sides on which Shelter factor Infiltration rate incorporat	the dwelling	g is sheltere actor	ed	(8), otherwi	se (18) = (1			1 -	0.075 x (1 (18) x (2		3] (18)] (19)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f	the dwelling ting shelter fa	g is sheltere actor vind speed	ed :			6)			(18) x (2	20) =	3 0.78 0.89] (18)] (19)] (20)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f	the dwelling ting shelter fa for monthly v Feb	g is sheltere actor vind speed Mar	ed	(8), otherwi May	se (18) = (1 Jun		Aug	1 - Sep			3 0.78] (18)] (19)] (20)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe	the dwelling ting shelter fa for monthly v Feb teed from Tab	; is sheltere actor vind speed Mar le U2	ed : Apr	Мау	Jun	6) Jul	Aug	Sep	(18) x (2 Oct	20) = Nov	3 0.78 0.89 Dec] (18)] (19)] (20)] (21)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10	the dwelling ting shelter fa for monthly v Feb	g is sheltere actor vind speed Mar	ed :			6)			(18) x (2	20) =	3 0.78 0.89] (18)] (19)] (20)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4	the dwelling ting shelter fa for monthly v Feb teed from Tab	; is sheltere actor vind speed Mar le U2 4.90	ed : Apr 4.40	May	Jun 3.80	6) Jul 3.80	Aug 3.70	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50	3 0.78 0.89 Dec 4.70] (18)] (19)] (20)] (21)] (22)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00	; is sheltere actor vind speed Mar le U2 4.90 1.23	ed : Apr 4.40	May 4.30	Jun 3.80	6) Jul	Aug	Sep	(18) x (2 Oct	20) = Nov	3 0.78 0.89 Dec] (18)] (19)] (20)] (21)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for	; is sheltere actor vind speed Mar le U2 4.90 1.23 shelter and	ed : Apr 4.40 1.10 I wind fact	May 4.30 1.08 tor) (21) x (2	Jun 3.80 0.95 22a)m	6) Jul 3.80 0.95	Aug 3.70 0.93	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50 1.13	3 0.78 0.89 Dec 4.70 1.18] (18)] (19)] (20)] (21)] (22)] (22a)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (1.13	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for 1.11	s is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 1.09	ed : Apr 4.40 1.10 I wind fact 0.98	May 4.30	Jun 3.80	6) Jul 3.80	Aug 3.70	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50	3 0.78 0.89 Dec 4.70] (18)] (19)] (20)] (21)] (22)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (1.13 Calculate effective air cha	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for 1.11 nge rate for t	s is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 1.09 the applical	ed : Apr 4.40 1.10 I wind fact 0.98 ble case:	May 4.30 1.08 tor) (21) x (2 0.96	Jun 3.80 0.95 22a)m	6) Jul 3.80 0.95	Aug 3.70 0.93	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50 1.13	3 0.78 0.89 Dec 4.70 1.18] (18)] (19)] (20)] (21)] (22)] (22a)] (22b)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (1.13 Calculate effective air cha If mechanical ventilation	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for 1.11 nge rate for t on: air change	g is sheltered actor wind speed Mar le U2 4.90 1.23 shelter and 1.09 the application e rate throu	ed Apr 4.40 1.10 I wind fact 0.98 ble case: ugh syster	May 4.30 1.08 tor) (21) x (2 0.96	Jun 3.80 0.95 22a)m 0.84	6) Jul 3.80 0.95 0.84	Aug 3.70 0.93	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50 1.13	3 0.78 0.89 Dec 4.70 1.18 1.04] (18)] (19)] (20)] (21)] (22)] (22a)] (22b)] (22a)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (1.13 Calculate effective air cha If mechanical ventilatio If balanced with heat r	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for 1.11 nge rate for t on: air change ecovery: efficient	s is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 1.09 the applical e rate throu ciency in %	ed Apr 4.40 1.10 wind fact 0.98 ble case: ugh syster allowing f	May 4.30 1.08 tor) (21) x (2 0.96 n for in-use fa	Jun 3.80 0.95 22a)m 0.84	6) Jul 3.80 0.95 0.84	Aug 3.70 0.93	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50 1.13	3 0.78 0.89 Dec 4.70 1.18] (18)] (19)] (20)] (21)] (22)] (22a)] (22b)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (1.13 Calculate effective air cha If mechanical ventilation	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for 1.11 nge rate for t on: air change ecovery: efficient	s is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 1.09 the applical e rate throu ciency in %	ed Apr 4.40 1.10 wind fact 0.98 ble case: ugh syster allowing f	May 4.30 1.08 tor) (21) x (2 0.96 n for in-use fa	Jun 3.80 0.95 22a)m 0.84	6) Jul 3.80 0.95 0.84	Aug 3.70 0.93	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50 1.13	3 0.78 0.89 Dec 4.70 1.18 1.04] (18)] (19)] (20)] (21)] (22)] (22a)] (22b)] (22a)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (1.13 Calculate effective air cha If mechanical ventilation If balanced with heat r d) natural ventilation c	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for 1.11 nge rate for t on: air change ecovery: effic or whole hous 1.11	s is sheltered actor wind speed Mar le U2 4.90 1.23 shelter and 1.09 the applicat e rate throu ciency in % se positive 1.09	ed Apr 4.40 1.10 wind fact 0.98 ble case: ugh syster allowing f input vent 0.98	May 4.30 1.08 tor) (21) x (2 0.96 n for in-use fa tilation fror 0.96	Jun 3.80 0.95 22a)m 0.84	6) Jul 3.80 0.95 0.84	Aug 3.70 0.93	Sep 4.00	(18) × (2 Oct 4.30	20) = Nov 4.50 1.13	3 0.78 0.89 Dec 4.70 1.18 1.04] (18)] (19)] (20)] (21)] (22)] (22a)] (22b)] (22a)
Number of sides on which Shelter factor Infiltration rate incorporat Infiltration rate modified f Jan Monthly average wind spe 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (1.13 Calculate effective air cha If mechanical ventilatio If balanced with heat r d) natural ventilation co	the dwelling ting shelter fa for monthly v Feb eed from Tab 5.00 1.25 allowing for 1.11 nge rate for t on: air change ecovery: effic or whole hous 1.11	s is sheltered actor wind speed Mar le U2 4.90 1.23 shelter and 1.09 the applicat e rate throu ciency in % se positive 1.09	ed Apr 4.40 1.10 wind fact 0.98 ble case: ugh syster allowing f input vent 0.98	May 4.30 1.08 tor) (21) x (2 0.96 n for in-use fa tilation fror 0.96	Jun 3.80 0.95 22a)m 0.84 actor from T n loft	6) Jul 3.80 0.95 0.84	Aug 3.70 0.93 0.82	Sep 4.00 1.00	(18) × (2 Oct 4.30 1.08 0.96	20) = Nov 4.50 1.13 1.00	3 0.78 0.89 Dec 4.70 1.18 1.04 N/A N/A] (18)] (19)] (20)] (21)] (22)] (22a)] (22a)] (22b)] (22b)] (23a)] (23c)



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3. Heat losses a	and heat lo	ss paramet	.ei										
Element			а	Gross rea, m²	Openings m ²	Net A,		U-value W/m²K	A x U W		value, /m².K	Ахк, kJ/K	
Window						5.	79 x	1.50	= 8.71				(27)
External wall						62	.74 x	0.28	= 17.57	 ·			(29a)
Roof						38	.50 x	0.11	= 4.24				(30)
Roof						16	.20 x	0.15	= 2.43				(30)
Total area of ext	ternal elem	ents ∑A, m²	2			123	3.23						(31)
Fabric heat loss,	W/K = Σ(A	× U)							(2	5)(30) + (3	32) =	32.94	(33)
Heat capacity Cr	m = ∑(А x к)							(28)	.(30) + (32)	+ (32a)(32	2e) =	N/A	(34)
Thermal mass pa		MP) in kJ/r	n²K									250.00	(35)
Thermal bridges				dix K								6.82	(36)
Total fabric heat										(33) + (3	36) =	39.76	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	loss calcula	ted month	ly 0.33 x (2	25)m x (5)									
	46.24	45.34	44.43	39.90	39.03	34.95	34.95	34.19	36.52	39.03	40.80	42.62	(38)
Heat transfer co	efficient, W	//K (37)m +	+ (38)m		I			•	•			•	
	86.00	85.10	84.19	79.67	78.79	74.71	74.71	73.95	76.28	78.79	80.56	82.38	1
									Average = 2	(39)112/	/12 =	79.59	(39)
Heat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.57	1.56	1.54	1.46	1.44	1.37	1.37	1.35	1.39	1.44	1.47	1.51	1
									Average = 2	(40)112/	/12 =	1.46	(40)
Number of days	in month (Fable 1a)								, ,			
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
	-	·	•		• •					•	•	·	-
4. Water heati	ng energy r	equiremen	t										7
Assumed occupa	ancy, N											1.83	(42)
Annual average	hot water u	isage in litre	es per day '	Vd,average	= (25 x N) +	36						77.63	(43)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage		-				le 1c x (43)						-
	85.39	82.29	79.18	76.08	72.97	69.87	69.87	72.97	76.08	79.18	82.29	85.39	
										∑(44)1	.12 =	931.54	(44)
Energy content	of hot wate	r used = 4.1	18 v Vd m v	nm x Tm/3	600 kWh/m	onth (see	Tables 1h						
						•		1c 1d)				-	-
	126.63	110.75	114.29	99.64	95.61	82.50	76.45	1c 1d) 87.73	88.77	103.46	112.93	122.64]
	126.63	110.75			95.61	82.50		,	88.77	103.46 ∑(45)1	· · · · ·	122.64 1221.40]] (45)
Distribution loss					95.61	82.50		,	88.77		· · · · ·]] (45)
Distribution loss					95.61	82.50		,	88.77		· · · · ·] (45) (46)
Distribution loss Water storage lo	5 0.15 x (45 18.99)m 16.61	114.29	99.64			76.45	87.73		∑(45)1	.12 =	1221.40	
	5 0.15 x (45 18.99)m 16.61	114.29	99.64			76.45	87.73		∑(45)1	.12 =	1221.40	
	5 0.15 x (45 18.99 Dss calculate)m 16.61 ed for each 0.00	114.29 17.14 month (55 0.00	99.64 14.95 5) x (41)m 0.00	14.34	12.38	76.45	87.73 13.16 0.00	13.32	∑(45)1 15.52	12 =	1221.40] (46)
Water storage lo	5 0.15 x (45 18.99 Dss calculate)m 16.61 ed for each 0.00	114.29 17.14 month (55 0.00	99.64 14.95 5) x (41)m 0.00	14.34	12.38	76.45	87.73 13.16 0.00	13.32	∑(45)1 15.52	12 =	1221.40] (46)
Water storage lo	5 0.15 x (45 18.99 Doss calculate 0.00 tains dedica 0.00)m 16.61 ed for each 0.00 ated solar s 0.00	114.29 17.14 month (55 0.00 torage or d 0.00	99.64 14.95 5) x (41)m 0.00 ledicated W	14.34 0.00 /WHRS (56)n	12.38 0.00 n x [(47) -	76.45 11.47 0.00 Vs] ÷ (47),	87.73 13.16 0.00 else (56)	0.00	Σ(45)1 15.52 0.00	12 = 16.94 0.00	1221.40] (46)] (56)
Water storage lo	5 0.15 x (45 18.99 Doss calculate 0.00 tains dedica 0.00)m 16.61 ed for each 0.00 ated solar s 0.00	114.29 17.14 month (55 0.00 torage or d 0.00	99.64 14.95 5) x (41)m 0.00 ledicated W	14.34 0.00 /WHRS (56)n	12.38 0.00 n x [(47) -	76.45 11.47 0.00 Vs] ÷ (47),	87.73 13.16 0.00 else (56)	0.00	Σ(45)1 15.52 0.00	12 = 16.94 0.00	1221.40] (46)] (56)
Water storage lo	5 0.15 x (45) 18.99 Doss calculate 0.00 tains dedica 0.00 Doss for each 0.00	0m 16.61 ed for each 0.00 ated solar s 0.00 0 month fro 0.00	114.29 17.14 month (55 0.00 torage or d 0.00 m Table 3 0.00	99.64 14.95 5) x (41)m 0.00 ledicated W 0.00	14.34 0.00 /WHRS (56)n 0.00	12.38 0.00 n x [(47) - 0.00	76.45 11.47 0.00 Vs] ÷ (47), 0.00	87.73 13.16 0.00 else (56) 0.00	0.00	Σ(45)1 15.52 0.00 0.00	12 = 16.94 0.00 0.00	0.00] (46)] (56)] (57)
Water storage lo If the vessel con Primary circuit lo	5 0.15 x (45) 18.99 Doss calculate 0.00 tains dedica 0.00 Doss for each 0.00	0m 16.61 ed for each 0.00 ated solar s 0.00 0 month fro 0.00	114.29 17.14 month (55 0.00 torage or d 0.00 m Table 3 0.00	99.64 14.95 5) x (41)m 0.00 ledicated W 0.00	14.34 0.00 /WHRS (56)n 0.00	12.38 0.00 n x [(47) - 0.00	76.45 11.47 0.00 Vs] ÷ (47), 0.00	87.73 13.16 0.00 else (56) 0.00	0.00	Σ(45)1 15.52 0.00 0.00	12 = 16.94 0.00 0.00	0.00] (46)] (56)] (57)
Water storage lo If the vessel con Primary circuit lo	 0.15 x (45) 18.99 pss calculate 0.00 tains dedica 0.00 oss for each 0.00 ach month 50.96 	m 16.61 ed for each 0.00 ated solar s 0.00 month fro 0.00 from Table 46.03	114.29 17.14 month (55 0.00 torage or d 0.00 m Table 3 0.00 3a, 3b or 3 50.96	99.64 14.95 5) x (41)m 0.00 edicated W 0.00 0.00 c 49.32	14.34 0.00 /WHRS (56)n 0.00 0.00 50.96	12.38 0.00 n x [(47) - 0.00 0.00 49.32	76.45 11.47 0.00 Vs] ÷ (47), 0.00 0.00 50.96	87.73 13.16 0.00 else (56) 0.00 0.00 50.96	13.32 0.00 0.00 0.00 49.32	Σ(45)1 15.52 0.00 0.00	12 = 16.94 0.00 0.00	0.00] (46)] (56)] (57)] (59)
Water storage lo If the vessel con Primary circuit lo Combi loss for e	 0.15 x (45) 18.99 pss calculate 0.00 tains dedica 0.00 oss for each 0.00 ach month 50.96 	m 16.61 ed for each 0.00 ated solar s 0.00 month fro 0.00 from Table 46.03	114.29 17.14 month (55 0.00 torage or d 0.00 m Table 3 0.00 3a, 3b or 3 50.96	99.64 14.95 5) x (41)m 0.00 edicated W 0.00 0.00 c 49.32	14.34 0.00 /WHRS (56)n 0.00 0.00 50.96	12.38 0.00 n x [(47) - 0.00 0.00 49.32	76.45 11.47 0.00 Vs] ÷ (47), 0.00 0.00 50.96	87.73 13.16 0.00 else (56) 0.00 0.00 50.96	13.32 0.00 0.00 0.00 49.32	Σ(45)1 15.52 0.00 0.00	12 = 16.94 0.00 0.00	0.00] (46)] (56)] (57)] (59)

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0 0.00		0.00	0.00	0.00	(63)
Flue gas heat ree	covery syste	em 1 input	(Appendix	G1)										
	-21.27	-18.61	-18.86	-16.24	-14.28	-10.93	-10.40	-11.	55 -11.5	7	-16.46	-18.51	-20.75	(63)
Output from wa	ter heater f	for each mo	onth (kWh/	month) (62	2)m + (63)m	1							_	-
	156.32	138.17	146.38	132.72	132.29	120.89	117.01	127.	14 126.5	2	137.95	143.74	152.85	1
				_							∑(64)1	I	1631.97	(64)
Heat gains from	water heat	ing (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 >	< [(46)m +	- (57)m +	(59)m]		2(0.)2] (0.)
	54.85	48.33	50.74	45.46	44.53	39.76	38.16	41.9	91 41.85	5	47.14	49.88	53.52	(65)
			•		•	•						•		-
5. Internal gain	S													
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Au	g Sep		Oct	Nov	Dec	
Metabolic gains	(Table 5)													
	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.	71 109.7	1	109.71	109.71	109.71	(66)
Lighting gains (c	alculated in	Appendix	L, equation	L9 or L9a),	also see Ta	able 5								
	40.41	35.89	29.19	22.10	16.52	13.95	15.07	19.	59 26.29)	33.38	38.96	41.53	(67)
Appliance gains	(calculated	in Appendi	x L, equatio	on L13 or L	13a), also se	ee Table 5								
	237.93	240.40	234.18	220.93	204.21	188.50	178.00) 175.	53 181.7	5	195.00	211.72	227.43	(68)
Cooking gains (c	alculated in	Appendix	L, equation	L15 or L15	a), also see	Table 5								-
	47.80	47.80	47.80	47.80	47.80	47.80	47.80	47.	30 47.80)	47.80	47.80	47.80	(69)
Pump and fan ga	ins (Table !	5a)			•									-
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.0	0 3.00		3.00	3.00	3.00	(70)
Losses e.g. evap	oration (Tal	ble 5)												
	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.14	-73.	14 -73.1	4	-73.14	-73.14	-73.14	(71)
Water heating g	ains (Table	5)												
	73.72	71.92	68.20	63.14	59.85	55.22	51.29	56.3	33 58.12	2	63.36	69.28	71.93	(72)
Total internal ga	ins (66)m -	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (7	72)m								_
	439.42	435.58	418.93	393.54	367.95	345.04	331.73	338.	82 353.5	3	379.11	407.32	428.26	(73)
6. Solar gains														
			Access f		Area		lar flux		g		FF		Gains	
			Table	60	m²	V	V/m²		specific data or Table 6b		specific d or Table		w	
SouthWest			1.0	0 x [2.97	x 3	36.79	x 0.9 x	0.85	x	0.70	=	58.52	(79)
NorthEast			0.3	0 ×	1.98		1.28	x 0.9 x	0.85] x [0.70		3.59	(75)
SouthEast			0.3		0.84		36.79	x 0.9 x	0.72] x [4.21	(77)

Solar gains in watts ∑(74)m...(82)m

	66.31	114.15	159.35	202.75	231.94	232.39	223.16	201.06	174.33	127.01	79.64	56.61	(83)
Total gains - inte	rnal and so	lar (73)m +	(83)m										
	505.74	549.73	578.28	596.28	599.89	577.43	554.89	539.88	527.86	506.12	486.97	484.87	(84)

7. Mean interna	al tempera	ture (heati	ng season)										
Temperature du	ring heating	g periods in	the living a	area from T	able 9, Th1	.(°C)						21.00	(85)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains f	or living are	ea n1,m (se	e Table 9a)									
	0.99	0.98	0.97	0.94	0.88	0.73	0.57	0.60	0.81	0.95	0.98	0.99	(86)
Mean internal te	mp of livin	g area T1 (s	steps 3 to 7	in Table 9c	:)								
	19.51	19.67	19.94	20.35	20.67	20.91	20.98	20.97	20.84	20.44	19.96	19.54	(87)
Temperature du	ring heatin	g periods in	the rest of	^f dwelling fr	rom Table 9	9, Th2(°C)							
	19.63	19.65	19.66	19.72	19.73	19.79	19.79	19.80	19.77	19.73	19.71	19.68	(88)

SAP version 9.92

Utilisation factor for	r gains for r	rest of dv	velling n2,	m									
	0.99	0.98	0.96	0.92	0.83	0.63	0.42	0.46	0.72	0.92	0.97	0.99	(89)
Mean internal temp	perature in	the rest o	of dwelling	g T2 (follow	v steps 3 to	7 in Table 9	e)						
1	18.33	18.50	18.78	19.21	19.51	19.75	19.78	19.79	19.68	19.32	18.83	18.40	(90)
Living area fraction									Li	ving area ÷	(4) =	0.48	(91)
Mean internal temp	perature for	r the who	ole dwellin	g fLA x T1 ·	+(1 - fLA) x ⁻	Т2							
	18.89	19.06	19.33	19.75	20.06	20.30	20.35	20.35	20.23	19.85	19.37	18.94	(92)
Apply adjustment to	o the mean	internal	temperati	ure from Ta	able 4e whe	ere appropr	iate						
1	18.89	19.06	19.33	19.75	20.06	20.30	20.35	20.35	20.23	19.85	19.37	18.94	(93)
8. Space heating re	equiremen							_					
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for	r gains, ηm											-	-
	0.98	0.98	0.96	0.92	0.84	0.67	0.49	0.52	0.76	0.92	0.97	0.99	(94)
Useful gains, ηmGm	n, W (94)m	x (84)m											_
4	197.26 5	36.26	555.32	550.41	506.31	389.37	273.13	283.10	401.19	467.05	473.46	477.89	(95)
Monthly average ex	ternal tem	perature	from Tabl	e U1									_
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for me	iean interna	al tempe	rature, Lm	, W [(39)m	n x [(93)m -	(96)m]							
12	254.61 1	204.82	1080.27	864.58	658.69	425.77	280.22	292.31	467.83	729.08	988.28	1214.47	(97)
Space heating require	irement, kV	Vh/mont	h 0.024 x	[(97)m - (9	95)m] x (41)	m							
5	563.47 4	49.27	390.56	226.20	113.37	0.00	0.00	0.00	0.00	194.95	370.68	548.01	
									Σ(9	8)15 <i>,</i> 10	.12 =	2856.51	(98)
Space heating requi	irement kW	/h/m²/ye	ar							(98)	÷ (4)	52.22	(99)
9a. Energy require	monts in	dividual	posting ov	stoms inclu	uding micro	СНР							
	intents - Inc	aiviuuai i	leating sys	stems men									
Space heating Fraction of space he	at from co	condon/		nton (custo	m (table 11							0.00	(201)
•				filary syste	en (table 11	L)				1 /2	01) [(201)
Fraction of space he		,	. ,							1 - (2	01) = [1.00	(202)
Fraction of space he									(2)	22) [4 /20		0.00	(202)
Fraction of total spa			-						(20	02) x [1- (20		1.00	(204)
Fraction of total spa			system 2							(202) x (2	03) = [0.00	(205)
Efficiency of main sy			Mor	A	May	1	11	A	Som	Oct		90.00	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (254.24	425.07		0.00			246.64	111.00	600.00	Т
6	526.08 4	99.19	433.96	251.34	125.97	0.00	0.00	0.00	0.00	216.61	411.86	608.90	
									Σ(21	1)15, 10	.12 =	3173.90	(211)
Water heating													
Efficiency of water h					1	L		L == == 1		1		1	
	I	87.40	87.00	85.98	84.26	79.90	79.90	79.90	79.90	85.52	86.93	87.59	(217)
Water heating fuel,							-					1	7
_ 1	178.46	58.08	168.25	154.35	156.99	151.30	146.45	159.12	158.35	161.31	165.35	174.51]
Annual totals										∑(219a)1	.12 =	1932.52	(219)
										∑(219a)1] (219) _
Space heating fuel -	- main syste	em 1								∑(219a)1		3173.90] (219)
Space heating fuel - Water heating fuel	-									∑(219a)1] (219)
Space heating fuel - Water heating fuel Electricity for pumps	os, fans and	electric l								∑(219a)1		3173.90]
Space heating fuel - Water heating fuel	os, fans and	electric l			ating unit				30.00	<u>Σ</u> (219a)1		3173.90	(219)]] (230c)

boiler flue fan			45.00			(230e)
Total electricity for the above, kWh/year					75.00	(231)
Electricity for lighting (Appendix L)					285.45	(232)
Energy saving/generation technologies						
electricity generated by PV (Appendix M)					-806.88	(233)
Total delivered energy for all uses		(211))(221) + (231) + ((232)(237b) =	4660.00	(238)
		()	,(, (,	,(,] (===)
10a. Fuel costs - individual heating systems including micro-Cl	HP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3173.90	x	3.48	x 0.01 =	110.45	(240)
Water heating	1932.52	x	3.48	x 0.01 =	67.25	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	285.45	x	13.19	x 0.01 =	37.65	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-806.88	x	13.19	x 0.01 =	-106.43	(252)
Total energy cost			(240)(242) +	(245)(254) =	238.82	(255)
11a. SAP rating - individual heating systems including micro-C	ΉР					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.01	(257)
SAP value					85.97]
SAP rating (section 13)					86	(258)
SAP band					В]
12. CO emissions individual kesting sustance including mis						
12a. CO ₂ emissions - individual heating systems including mic			Emission factor		Emissions	
	Energy kWh/year		kg CO ₂ /kWh		kg CO₂/year	
Space heating - main system 1	3173.90	x	0.22	=	685.56	(261)
Water heating	1932.52	x	0.22	=	417.43	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	1102.99	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	285.45	x	0.52	=	148.15	(268)
Energy saving/generation technologies						
pv savings	-806.88	х	0.52	=	-418.77	(269)
Total CO₂, kg/year				(265)(271) =	871.29	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.93	(273)
El value					88.29	
El rating (section 14)					88	(274)
El band					В]
13a. Primary energy - individual heating systems including mi	cro-CHP					
	Energy kWh/year		Primary factor		Primary Energy kWh/year	,
Space heating - main system 1	3173.90	x	1.22	=	3872.16	(261)

Water heating	1932.52	x	1.22] = [2357.68	(264)
Space and water heating			(261) + (262) +	(263) + (264) = [6229.84	(265)
Pumps and fans	75.00	x	3.07] = [230.25	(267)
Electricity for lighting	285.45	x	3.07	= [876.33	(268)

Energy saving/generation technologies

Electricity generated - PVs

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

(269)

(272) (273)

-2477.13

4859.30

88.84

-806.88

3.07

Appendix B – BREEAM Assesment

BREEAM UK Domestic Refurbishment 2014 Pre-Asses	ssment Estimator v0.1		BREEAM [®] UK
This assessment and indicative BREEAM rating is not a formal of	certified BREEAM assessment or rating and must n	ot	
be communicated as such. The score presented is indicative of	a dwelling's potential performance and is based o	n Minimum	Standards
a simplified pre-formal BREEAM assessment and unverified co	mmitments given at an early stage in the design	Pass Good Very Good	
process.		Ene 02 🗹 🗹	4 4
Building name	179-181 High Street Hampton Hill	Wat 01 🗹 🗹 🗸	✓ ×
Indicative building score (%)		Hea 05 🗹 🗹 🗸	4 4
Indicative BREEAM rating	BREEAM Excellent	Hea 06 🗹 🗹 🗸	4 4
Management Health & Wellbeing Energy W	/ater Materials Waste Pollution	Pol 03 ✓ ✓ ✓ Mat 02 ✓ ✓ ✓	
INNOVATION	Section Weighting: 10%	Indicative Section Score	: 2.00%
Comments			
MANAGEMENT	Section Weighting: 12%	Indicative Section Score	: 5.45%
Man 01 Home Users Guide			
No. of BREEAM credits available 3	Available co	ntribution to overall score 3.	27%
No. of BREEAM innovation credits 0	Minin	num Standards applicable:	No
Assessment Criteria			Indicative Credits
Where a Home Users Guide be provided to all dwellings, cover	ing all issues set out in the 'Users Guide Contents I	ist', three credits may be awarded 🛄	3
	0		
Comments			
Man 02 Responsible Construction Practices			
No. of BREEAM credits available 2	Available co	ntribution to overall score: 2.	18%
No. of BREEAM innovation credits 1		Minimum Standards	No
Assessment Criteria		· · · · · ·	Indicative Credits
Where a compliant considerate construction scheme will be us	sed, credits are awarded depending the score achie	eved as outlined below:	1
Large Scale - project with more than 5 units			
	One Credit	Two Credits	
Considerate Constructors Scheme	Score of 25-34 with a score of 5 in each section	Score of 35-39 with a score of 7 in each section	
Alternative Compliant Scheme	Compliance	Beyond Compliance	

Small Scale - project with 5 units or fewer				
	One Cre	dit	Two Credits	
Considerate Constructors Scheme	Score of 25-34 with a score	e of 5 in each section	Score of 35-39 with a score of 7 in eac section	h
Alternative Compliant Scheme	Compliar	nce	Beyond Compliance	
Checklist A-3	50% of the optio	onal items	80% of the optional items	
Exemplary Credit				Indicative Innov
Considerate Constructors Scheme	Score of 40 or more with section]	Credits Achiev
Alternative Compliant Scheme	Exemplary Level (Compliance		-
Checklist A-3*	All Items (Optional a	& Mandatory)	* Small Scale Project Only	
ents				
03 Construction Site Impacts				
3 Construction Site Impacts . of BREEAM credits available 1				1.09%
OBJ Construction Site Impacts . of BREEAM credits available 1 of BREEAM innovation credits 0 ment Criteria			ontribution to overall score 1 nimum Standards applicable	
3 Construction Site Impacts . of BREEAM credits available 1 of BREEAM innovation credits 0	nitored, as detailed below:	Min	nimum Standards applicable	No
3 Construction Site Impacts . of BREEAM credits available 1 of BREEAM innovation credits 0 ment Criteria		Min One Crec	nimum Standards applicable	No Indicative Cred
3 Construction Site Impacts of BREEAM credits available 1 f BREEAM innovation credits 0 ment Criteria		Min One Crec	himum Standards applicable	No Indicative Cred
3 Construction Site Impacts . of BREEAM credits available 1 of BREEAM innovation credits 0 ment Criteria evidence demonstrate that site impacts will be model	Where there is evidence t	Min One Crec o demonstrate that 2 are comple	himum Standards applicable	No Indicative Cred
3 Construction Site Impacts of BREEAM credits available 1 of BREEAM innovation credits 0 ment Criteria 0 evidence demonstrate that site impacts will be mo Large Scale	Where there is evidence t Where there is evidence t	Min One Crea o demonstrate that 2 are comple o demonstrate that 2 are comple	himum Standards applicable	No Indicative Cred
3 Construction Site Impacts . of BREEAM credits available 1 of BREEAM innovation credits 0 ment Criteria evidence demonstrate that site impacts will be modeling Large Scale	Where there is evidence t Where there is evidence t Sections of Checklis	Min One Crec o demonstrate that 2 are comple o demonstrate that 2 are comple	himum Standards applicable	No Indicative Cred

Nonitor, report and set targets for water consumption arising from site activities	Set objectives for reducing water use arising from site activities
A main contractor with an environmental materials policy	activities
	Main contractor environmental materials statement
A main contractor that operates an Environmental Management System	
80% of site timber is reclaimed, re-used or responsibly sourced	80% of site timber is reclaimed, re-used or responsibly sourced
Same definition of small and large scale as in Man 02	

No. of BREEAM credits available 2 No. of BREEAM innovation credits 0	Available contribution to overall score: 2.18% Minimum Standards applicable: No	
sessment Criteria		Indicative Credits
here the following requirements will be met:		0
One Credit Secure windows and doors	External doors and accessible windows meet minimum standards and appropriately certified	
	Principles and guidance of Secured by Design Section 2 are complied with	
Two Credits Secured by design	A suitably qualified security consultant is consulted at the design stage and their recommendations are incorporated into the refurbishment	
omments		
Omments Ann 05 Protection and Enhancement of Ecological Feature No. of BREEAM credits available 1 No. of BREEAM innovation credits 1	Available contribution to overall score: 1.09%	
Nan 05 Protection and Enhancement of Ecological Fear No. of BREEAM credits available No. of BREEAM innovation credits 1 ssessment Criteria	Available contribution to overall score: 1.09%	Indicative Credits
Aan 05 Protection and Enhancement of Ecological Fear No. of BREEAM credits available 1 No. of BREEAM innovation credits 1 ssessment Criteria 1 /here the following requirements will be met: 1	Available contribution to overall score: 1.09%	
Ann 05 Protection and Enhancement of Ecological Fear No. of BREEAM credits available 1 No. of BREEAM innovation credits 1 ssessment Criteria 1	Available contribution to overall score: 1.09% Minimum Standards applicable: No	
Ian 05 Protection and Enhancement of Ecological Fear No. of BREEAM credits available 1 No. of BREEAM innovation credits 1 ssessment Criteria 1 here the following requirements will be met: 0 One Credit 0	Available contribution to overall score: 1.09% Minimum Standards applicable: No Site survey carried out to determine presence of ecological features Site survey carried out to determine presence of ecological features Statutory Nature Conservation Organisation notified of protected species Features of ecological value protected during refurbishment works	0
Man 05 Protection and Enhancement of Ecological Fear No. of BREEAM credits available 1 No. of BREEAM innovation credits 1 ssessment Criteria 1 /here the following requirements will be met: 0 One Credit 0	Available contribution to overall score: 1.09% Minimum Standards applicable: No Site survey carried out to determine presence of ecological features Image: Conservation Organisation notified of protected species Statutory Nature Conservation Organisation notified of protected species Features of ecological value protected during refurbishment works	0 ndicative Innovati
Man 05 Protection and Enhancement of Ecological Fear No. of BREEAM credits available 1 No. of BREEAM innovation credits 1 sssessment Criteria 1 /here the following requirements will be met: 0 One Credit Protecting Ecological Features	Available contribution to overall score: 1.09% Minimum Standards applicable: No Site survey carried out to determine presence of ecological features Site survey carried out to determine presence of ecological features Statutory Nature Conservation Organisation notified of protected species Features of ecological value protected during refurbishment works	0
Man 05 Protection and Enhancement of Ecological Fear No. of BREEAM credits available 1 No. of BREEAM innovation credits 1 ssessment Criteria 1 /here the following requirements will be met: 0 One Credit 0	Available contribution to overall score: 1.09% Minimum Standards applicable: No Site survey carried out to determine presence of ecological features Site survey carried out to determine presence of ecological features Statutory Nature Conservation Organisation notified of protected species Features of ecological value protected during refurbishment works A suitably qualified ecologist recommends features to enhance ecology of	0 ndicative Innovati Credits Achieved

o. of BREEAM credits available 2	Available contribution to overall score 2.18	3%
of BREEAM innovation credits 2	Minimum Standards applicable No	
sment Criteria		Indicative Credi
e the following requirements will be met:		0
	Where all of the project team are involved in the project decision making	
	Small Scale - the project manager assigns individual and shared responsibilities amongst	
	the project team including all trades on site	
One Credit	Large Scale - the project manager assigns individual and shared responsibilities across	
	the following key design and refurbishment stages:	
Project Roles and Responsibilities	i. Planning and Building control notification	
	ii. Design	
	iii. Refurbishment	
	iv. Commissioning and handover	
	v. Occupation	
Curall Casta music star fina unita au fauran and	Large Scale projects: more than five units and more than	
Small Scale projects: five units or fewer and	Large Scale projects: more than five units and more than	
Small Scale projects: five units or fewer and	Large Scale projects: more than five units and more than	
Small Scale projects: five units or fewer and	Large Scale projects: more than five units and more than £100k	
	Large Scale projects: more than five units and more than £100k Handover meeting arranged	
Small Scale projects: five units or fewer and l One Credit	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to:	
One Credit	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation	
	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or	
One Credit	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation	
One Credit	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual	Indicative Innova
One Credit Handover and Aftercare	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of	Credits Achieve
One Credit	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation	
One Credit Handover and Aftercare Exemplary Credits	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation Where A BREEAM Accredited Professional has been appointed to oversee key stages	Credits Achieve
One Credit Handover and Aftercare	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation	Credits Achieve
One Credit Handover and Aftercare Exemplary Credits	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation Where A BREEAM Accredited Professional has been appointed to oversee key stages	Credits Achiev
One Credit Handover and Aftercare Exemplary Credits	Large Scale projects: more than five units and more than £100k Handover meeting arranged 2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation Where A BREEAM Accredited Professional has been appointed to oversee key stages within the project.	Credits Achieve

Earry Design Input	stage of the project, prior to the production of a refurbishment specification
One Exemplary Credit	Where Thermographic surveying and Airtightness testing have been carried out at both pre and post refurbishment stages
Thermographic Surveying and Airtightness Testing	Where an improved air tightness target has been set at design stage and testing demonstrates that this has been achieved post refurbishment
Comments	

	Section Weighting: 17% Indicative Section Score 14.17%	
a 01 Daylighting		
No. of BREEAM credits available2o. of BREEAM innovation credits0	Available contribution to overall score 2.83% Minimum Standards applicable No	
essment Criteria Where the refurbishment results in a neutral impac credits may be awarded as follows: For Existing Dwellings and Change of Use Projects	t on daylighting or where minimum daylighting standards are met, up to two 2	Credits
First Credit Maintaining Good Daylighting	The refurbishment results in a neutral impact on the dwellings daylighting levels in the kitchen, living room, dining room and study	
Where the property is being extended		
	New spaces achieve minimum daylighting levels	
First Credit Maintaining Good Daylighting	The extension does not significantly reduce daylighting levels in the kitchen, living room, dining room or study of neighbouring properties	
For All Properties		
Second Credit Minimum Daylighting	The dwelling achieves minimum daylighting levels in the kitchen, living room, dining room and study	
aments		
nments a O2 Sound Insulation No. of BREEAM credits available 4	Available contribution to overall score 5.67%	
a 02 Sound Insulation No. of BREEAM credits available 4 o. of BREEAM innovation credits 0	Minimum Standards applicable No	Credits
a 02 Sound Insulation No. of BREEAM credits available 4 o. of BREEAM innovation credits 0 essment Criteria	Minimum Standards applicable No Indicative Indicative tion standards and so minimise the likelihood of noise complaints. 4	Credits
a 02 Sound Insulation No. of BREEAM credits available 4 o. of BREEAM innovation credits 0 essment Criteria To ensure the provision of acceptable sound insulat	Minimum Standards applicable No Indicative Indicative tion standards and so minimise the likelihood of noise complaints. 4	Credits
a 02 Sound Insulation No. of BREEAM credits available 4 o. of BREEAM innovation credits 0 essment Criteria To ensure the provision of acceptable sound insulat Properties where sound testing has been carried o Up to Four Credits	Minimum Standards applicable No tion standards and so minimise the likelihood of noise complaints. Indicative out: 4 Four credits awarded according to the improvement over building regulations. See table See table	Credits

Up to Four Credits	Where a Suitably Qualified Acoustician (SQA) provides recommendations for the specification of all existing separating walls and floors
	SQA confirms in their professional opinion that they have the potential to meet or exceed the sound insulation credit requirements
	Where these recommendations are implemented
	See table in additional information in Technical Manual
Historic Buildings	
	Where the dwelling is a Historic Building and sound testing results demonstrate existin separating walls and floor meet the Historic Building credit requirements
Up to Four Credits	See table in additional information in Technical Manual
	Where sound testing is not feasible and not required by the appointed Building Contro body meeting criteria 2 and 3 using Table 12
	Properties where sound testing has been carried out, credits awarded according to th improvement over building regulations. See table in additional information in Technic. Manual
	Where the dwelling is a detached property
	Where the dwelling is a propertywith separating walls or floors only between non habitable rooms OR Testing not required by building control body
Detached Properties	
Four Credits	By Default
Properties with separating walls or floors only betw Four Credits	een non habitable rooms OR Testing not required by building control body By Default

No. of BREEAM credits available1No. of BREEAM innovation credits0	Available contribution to overall score 1.42% Minimum Standards applicable No	
sessment Criteria Where the refurbishment avoids the use of VC	Cs with new products meeting the following requirements:	Indicative Credits 1
	Where all decorative paints and varnishes used in the refurbishment have met the requirement listed in table 5.4 in the Technical Manual	
One Credit Avoiding the use of VOCs	Where at least five of the eight remaining product categories listed in table 5.4 have met the testing requirements and emission levels for Volatile Organic Compound (VOC) emissions against the relevant standards identified within table 5.4 in the Technical Manual	
	Where five or less products are specified within the refurbishment, all must meet the requirements in order to achieve this credit.	

Hea 04 Inclusive					
	l credits available		Available co	ntribution to overall score 2.	83%
No. of BREEAM i		1	Minir	mum Standards applicable	No
Assessment Criteri					Indicative Credits
	atement has bee	n carried out using Checklis	st A-8 of the Technical Manual to optimise the acce	essibility of the home as	0
follows:					
			Checklist A-8 of the Tech		_
	0	No 194	Section 1	Section 2	_
	One C		Completed with Evidence		
	Minimum A Two C		· · · · · · · · · · · · · · · · · · ·		-
			Completed with Evidence	Completed with Evidence	
	Advanced A	Accessibility	•	•	
Exemplar	y Performance				Indicative Innovation
		Where an access expert s	uitably qualified member of the design team has c	completed sections 1, 2	Credits Achieved
C	ne Credit	and 3 of Checklist A-8, ac	cess statement template with evidence provided o	of the measures	
		implemented in the refur	bishment		
		· ·			
Comments					
Hea 05 Ventilatio	on				
No. of BREEAM	l credits available	2	Available co	ntribution to overall score 2.	83%
No. of BREEAM i		0	Minir	mum Standards applicable	/es
Assessment Criteri	а				Indicative Credits
Where th	e dwelling meets	the following ventilation re	equirements:		2
			A minimum level of background ventilation is pro	ovided (with trickle ventilators or other	
			means of ventilation) for all habitable rooms, ki	itchens. utility rooms and bathrooms	
			compliant with section 7, Building Regulation	-	
			compliant with section 7, building Regulation.		
					-
	One C	redit	A minimum level of extract ventilation is provide	ed in all wet rooms (e.g. kitchen, utility	
•		ion Requirements	and bath-rooms), compliant with section 5, Build	ding Regulations Approved Document	
ľ		ion Requirements	Part F 2010).	
					-
			A minimum level of purge ventilation is provided	l in all habitable rooms and wet rooms,	
			compliant with section 7, Building Regulations		
			······································	- FF	

	It is an historic building and meets historic building requirements in CN4 of the technical manual	
Two Credits	Ventilation is provided for the dwelling that meets the requirements of Section 5 of Building Regulations Part F in full	
Advanced Requirements	Where the building is a historic building and meets the requirements for Historic Buildings in compliance note 4 of the technical manual	
Comments		
Hea 06 Safety No. of BREEAM credits available 1	Available contribution to overall score 1.42%	
No. of BREEAM innovation credits 0	Minimum Standards applicable Yes	1**
Assessment Criteria Where a fire and carbon monoxide (CO) detection	n and alarm system is specified as follows:	edits
where a fire and carbon monoxide (CO) detection		
	Where a compliant fire detection and fire alarm system is provided	
One Credit F ire and Carbon Monoxide (CO) Detection and Alarm Systems	Carbon Monoxide detector installed if dwelling is supplied with mains gas or other fossil fuel	
	Mains supplied fire detection and alarm system if project involves re-wiring*	
	Battery operated fire detection and alarm system if no re-wiring* is to take place	
* see CN9 in Hea 06 for the definition of re-wirin	g	
ENERGY	Section Weighting: 43% Indicative Section Score 34.84%	
Ene 01 Improvement in Energy Efficiency Rating No. of BREEAM credits available 6	Available contribution to overall score 8.90%	
No. of BREEAM innovation credits 0	Minimum Standards applicable No	
Assessment Criteria	Indicative Cro	edits
Where the following targets are met for the improvement	in Energy Efficiency Rating achieved as a result of refurbishment:	

	Improvement in EER	Credits
	≥ 5	0.5
	≥ 9	1
	≥ 13	1.5
	≥ 17	2
	≥ 21	2.5
	≥ 26	3
	≥ 31	3.5
	≥ 36	4
	≥ 42	4.5
	≥ 48	5
	≥ 54	5.5
	≥ 60	6
omments		

	t Refurbishment					
No. of BREEAM credits available	4	Available con	tribution to overall score 5.9)3%		
No. of BREEAM innovation credits	2	Minimum Standards applicable				
Assessment Criteria				Indicative Credits		
Where the following Energy Efficiency	Rating benchmarks will be met as a result of refurbis			4		
	EER post refurbishment	Credits	Minimum requirements			
	≥50	0.5	'Pass' level EER of 50			
	≥55	1	'Good' level EER of 58			
	≥60	1.5		_		
	≥65	2	'Very Good level' EER of 65			
	≥70	2.5	'Excellent' level EER of 70			
	≥75	3				
	≥80	3.5	'Outstanding' level EER of 81			
	≥85	4				
-			-	Indicative Innovation		
	Exemplary	Credits		Credits Achieved		
	≥90	1		1		
	≥100	2				
Comments						
Comments Ene 03 Primary energy demand No. of BREEAM credits available	7		tribution to overall score 10.	38%		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits	7 0	Available con		lo		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0	Available con Minim		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0 Demand benchmarks will be met as a result of refurbis	Available con Minim		lo		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0 Demand benchmarks will be met as a result of refurbis Primary Energy Demand Post Refurbishment	Available con Minim shment: Credits		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0 Demand benchmarks will be met as a result of refurbis Primary Energy Demand Post Refurbishment ≤ 400	Available con Minim shment: <u>Credits</u> 0.5		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	O Demand benchmarks will be met as a result of refurbis Primary Energy Demand Post Refurbishment ≤ 400 ≤ 370	Available con Minim shment: 0.5 1		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	O Demand benchmarks will be met as a result of refurbis Primary Energy Demand Post Refurbishment ≤ 400 ≤ 370 ≤ 340	Available con Minim shment: <u>Credits</u> 0.5		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0 Demand benchmarks will be met as a result of refurbis Primary Energy Demand Post Refurbishment ≤ 400 ≤ 370 ≤ 340 ≤ 320	Available con Minim shment: 0.5 1 1.5 2		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0 Demand benchmarks will be met as a result of refurbis Primary Energy Demand Post Refurbishment ≤ 400 ≤ 370 ≤ 340 ≤ 320 ≤ 300	Available con Minim shment: 0.5 0.5 1 1.5 2 2.5		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0 Demand benchmarks will be met as a result of refurbis Primary Energy Demand Post Refurbishment ≤ 400 ≤ 370 ≤ 340 ≤ 320 ≤ 300 ≤ 280	Available con Minim shment: 0.5 1 1.5 2 2.5 3		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	ODemand benchmarks will be met as a result of refurbisPrimary Energy Demand Post Refurbishment ≤ 400 ≤ 370 ≤ 340 ≤ 320 ≤ 300 ≤ 280 ≤ 260	Available con Minim shment: 0.5 1 1.5 2 2.5 3 3.5		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	0 Demand benchmarks will be met as a result of refurbisPrimary Energy Demand Post Refurbishment ≤ 400 ≤ 370 ≤ 340 ≤ 320 ≤ 300 ≤ 280 ≤ 260 ≤ 240	Available con Minim shment: 0.5 1 1.5 2 2.5 3 3.5 4		lo Indicative Credits		
Ene 03 Primary energy demand No. of BREEAM credits available No. of BREEAM innovation credits Assessment Criteria	ODemand benchmarks will be met as a result of refurbisPrimary Energy Demand Post Refurbishment ≤ 400 ≤ 370 ≤ 340 ≤ 320 ≤ 300 ≤ 280 ≤ 260	Available con Minim shment: 0.5 1 1.5 2 2.5 3 3.5		lo Indicative Credits		

I		< 400				
		≤ 180 ≤ 160	5.5			
			6			
	≤ 140		6.5			
		≤ 120	7			
Comments						
Fue O4 Depoweble Technologies						
Ene 04 Renewable Technologies No. of BREEAM credits available	2		Available c	ontribution to overall sco	re 2.97%	
No. of BREEAM innovation credits				imum Standards applicab		4
Assessment Criteria	S U		14111	innum Standards applicab		ive Credits
Where the dwelling will meet the fo	llowing % contribution fr	om renewables and primary en	ergy demand target	s as a result of	Indicat	2
refurbishment		on renewables and printary en	city actitation target			2
			Percentage fro	m Renewables		
	Dwelling Type	Primary Energy Demand	1 Credit	2 Credits		
	Detached		≥10%	≥20%		
	Semi-Detached		≥10%	≥20%		
	Bungalow	≤ 250 kWh/m²/year	≥10%	≥20%		
	End of Terrace		≥10%	≥20%		
	Mid Terrace		≥10%	≥20%		
	Low Rise Flat	- 3.	≥10%	≥20%		
	Mid Rise Flat	≤ 220 kWh/m²/year	≥10%	≥15%		
	High Rise Flat		≥10%	≥15%		
Comments						
Ene 05 Energy Labelled White Go	ods					
No. of BREEAM credits available			Available c	ontribution to overall sco	re 2.97%	
No. of BREEAM innovation credits	5 0	Minimum Standards applicable No			1	
Assessment Criteria	-			••		ive Credits
Where Energy Efficiency White good	ds are to be provided as f	ollows:				1
First Credit					F	
	iance	Appliance prov	vided	Appliance not to be	provided	
				EU Energy Efficiency Lab		
Evidence E	ad Faides Fasses	A+ Rating under EU Energy E	Efficiency Labelling		-	
Fridges, Freezers a	na Fridge-Freezers	Scheme		Information Leaflet pro	ovided to all	
				dwellings		

Appliance	Appliance provided	Appliance not to be provided
Washing Machines and Dishwashers	Washing Machine A++ under EU Energy Efficiency Labelling Scheme AND Dishwasher A+ uner EU Energy Efficiency Labelling Scheme	Second credit not achieved
Washer-Dryers and Tumble Dryers	Appliances specified with A Rating under EU Energy Efficiency Labelling Scheme	EU Energy Efficiency Labelling Scheme Information Leaflet provided to all dwellings

Comments

Ene 06 Drying Space				
No. of BREEAM credits available 1		Available contr	ibution to overall score	1.48%
No. of BREEAM innovation credits 0		Minimum Standards applicable No		
Assessment Criteria				Indicative Credits
Where adequate, secure internal or external space with posts a		vided with the following:		
	1 Credit			
	Number of bedrooms	Drying line require	ed	
	1-2	4m+		
	3+	6m+		
Comments				
Ene 07 Lighting		A 11 1 1		2.070/
No. of BREEAM credits available 2			ibution to overall score	2.97%
No. of BREEAM innovation credits 0 Assessment Criteria		IVIINIMU	m Standards applicable	No Indicative Credits
	d as follows:			
Where energy efficient internal and external lighting is provide	u as follows:			2
External Lighting - 1	hting of more than 45 lumer	ns ner circuit watt and En	ergy Efficient	
Security Lighting OR		is per circuit watt and En		
Where Energy Efficient Sr	bace Lighting is provided ON	IΥ		
Internal Lighting - 1				
Comments	ge across the total floor area	i of the dwelling of 9 watt	.5/11/2	
comments				
Ene 08 Display Energy Devices				
No. of BREEAM credits available 2		Available contr	ibution to overall score	2.97%
No. of BREEAM innovation credits 1			m Standards applicable	No
Assessment Criteria				Indicative Credits
Where consumption data is displayed to occupants by a compl	iant energy display device			2
		Primary He	eating Fuel	,
Electricity usag	ge data displayed	Electricity	Other	
Electricity usas	ge data displayed	2 credits awarded	1 credit awarded	
	el usage data displayed	N/A	1 credit awarded	
Electricity & Primary He	ating Fuel usage displayed	N/A	2 credits awarded	

	One credit Recording consumption data		Where the first two credits are achieved Where any compliant Energy Display Device is capable of recording consumption data			ve Innovation ts Achieved 1	
Comments							
Ene 09 Cycle Storage							
No. of BREEAM credits available	2		Available contribution t	o overall score	2.97%		
No. of BREEAM innovation credits	0		Minimum Standa	ards applicable	No		
Assessment Criteria		-			Indica	ative Credits	
Where individual or communal comp						2	
	Dwelling Size	One Credit	Two Credits				
	Studios/ 1 bedroom	1 per two dwellings	1 per dwelling				
	2-3 bedrooms	1 per dwelling	2 per dwelling				
	4 bedrooms	2 per dwelling	4 per dwelling				
Comments							
Ene 10 Home Office No. of BREEAM credits available	1		Available contribution t		1 400/		
No. of BREEAM innovation credits			Minimum Standa		<u>1.48%</u> No	-	
Assessment Criteria	5 U				-	ative Credits	
Where sufficient space and services	will be provided to allow o	occupants to set up a home	office in a suitable room with adeq	uate		0	
ventilation							
Comments	T						

	WATER	ATER Section Weighting: 11% Indicative Section Score 8.80%		e 8.80 %		
Wat 01	Internal Water Use					
	of BREEAM credits available BREEAM innovation credits			Available contribution t Minimum Stand		60% Yes
	nent Criteria	tion mosts the following co	procumption bonchmarks, or	where terminal fittings meet the	following	Indicativ
	onsumption standards:	cion meets the following co	insumption benchmarks, or	where terminal intrings meet the		·
	Calculated Water Consumption (litres/person/day)	Equivalent termina	al fitting standards	Minimum Standard	Credits	
	>150	Typical baselin	e performance	N/A	0	
	from 140 to ≤ 150	All showers specified to 'Good' OR All taps and WC's to 'Good' OR Kitchen fittings specified to 'Excellent'		N/A	0.5	_
	from 129 to < 140	•	Excellent' OR All showers taps to 'Good'	BREEAM Very Good	1	
	from 118 to < 129	'Good' OR All bathroc	oom fittings specified to om fittings specified to ellent'	N/A	1.5	
	from 107 to < 118	'Excellent' OR All Bathro 'Excellent' and WC room OR All Bathroom fittings,	oom fittings specified to oom fittings Specified to fitting specified to 'Good' kitchen and utility sittings to 'Good'	BREEAM Excellent	2	
	from 96 to < 107	fittings specified to 'Go	tility room and WC room bod' OR All bathrooms, hs specified to 'Excellent'	N/A	2.5	
	< 96	room, kitchen and utility	ified to 'Excellent' and WC room fittings specified to pod'	BREEAM Outstanding	3	

NOTE: 'Good' fittings are eq	uivalent to good practice	e fittings with "Excellent" fit	tings equivalent to best practice fitting	gs (see the technical	-
manual for full details.					Indicative Innovation
			If the water consumption is less		Credits Achieved
		Exemplary Credit	than 80l/person/day		0
Comments					
Wat 02 External Water Use					
No. of BREEAM credits available			Available contribution to o		20%
No. of BREEAM innovation credits	0		Minimum Standard	ls applicable N	lo
Assessment Criteria					Indicative Credits
Where the following requirements wi	ill be met:				1
	Requirements:				
	One Credit	been provided to dwelling OR	ater collection system for external/inte gs. individual or communal garden space.		
Comments		0	.		1
Wat 03 Water Meter					
No. of BREEAM credits available	1		Available contribution to o	overall score 2.2	20%
No. of BREEAM innovation credits	0		Minimum Standard	ls applicable N	lo
Assessment Criteria					Indicative Credits
Where an appropriate water meter for	or measuring usage of ma	ains potable water meter ha	as been provided to dwelling(s), one cr	redit may be 🛛 🗖	1
awarded					
Comments					
MATERIALS		Section Weighting: 8%		Indicative Section Score	4.00%
Mat 01 Environmental Impact of M	laterials				
No. of BREEAM credits available	25		Available contribution to c	overall score 4 1	.6%
No. of BREEAM innovation credits	0	-	Minimum Standard		lo
Assessment Criteria					Indicative Credits

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Up to 25 credits can be awarded, with credits calculated using the Mat 01 calculator tool. The table below shows the maximum number of credits available for each element:

Elements	Green Guide Rating credits available	Thermal performance credits
Roof	5	3
External walls	5	3.8
Internal walls (including separating walls)	5	-
Upper and Ground Floor	5	1.2
Windows	5	2
	containing refurbished or existing materials that r	
GG Rating	Points for existing / refurbished elements	Points for new elements
A+ (6)	5	
A+ (5)	4.6	
A+ (4)	4.2	
A+ (3)	3.8	
A+ (2)	3.4	
A+	3	3
A	2	2
В	1	1
С	0.5	0.5
D	0.25	0.25
E	0	0

Where the full 25 credits cannot be achieved the score can be 'topped up' with thermal performance credits. The full number of thermal performance credits for each element can be achieved when achieving the minimum U-values shown below.

Elements	Minimum U-Value
Roof	0.11
External walls	0.15
Internal walls (including separating walls)	-
Upper and Ground Floor	0.15
Windows	1.4
s de la constante de	

Comments

Mat 02 Responsible Sourcing of Mat	erials			
No. of BREEAM credits available	15		Available contribution to overa	all score 2.50%
No. of BREEAM innovation credits	0		Minimum Standards ap	
Assessment Criteria				Indicative Credits
Where new materials are responsibly s	sourced, up to 12 credits	may be awarded where 80%	of new materials for an element are	
responsibly sourced. The credits achie	ved are dependent on %	of point achieved which is ba	ased upon the responsible sourcing tier l	level of
each material sourced as detailed belo				
		stainable Procument Plan (3		Will all new timber used in the project
Т	he principal contractor s	ources materials for the proj	ect in accordance with a documented	be sourced in accordance with the UK
SI	ustainable procurement			Government's Timber Procurement
	OR Where the prin	cipal contractor is a Small Co	ompany (up to 3 BREEAM credits)	Yes
	Ch	ecklist A-9 is filled in with sup	oporting evidence	
				_
Table 1	BREEA	M credits	% of available points achieved	
		12	≥54%	
		10	≥45%	
		8	≥36%	
		6	≥ 27%	1
		4	≥ 18%]
		2	≥ 9%	
Comments				-
Mat 03 Insulation				
No. of BREEAM credits available	8		Available contribution to overa	
No. of BREEAM innovation credits	0		Minimum Standards ap	
Assessment Criteria Where any new insulation specified for	r uso within ovtornal wal	le ground floor roof and buil	Idings convises most the following	Indicative Credits
	r use within external war	is, ground noor, roor and bui	idings services meet the following	8
requirements:	equirements			
	equilements			
		Where the Insulation Index	x for new insulation used in the buildings	s is ≥2
	4 Credits			
		Where Green Guide ratir	ngs are determined using the Green Guid	de to
			specification tool	
R	equirements			
	•	Where \geq 80% of the new the	ermal insulation used in the building eler	nents is
I I	4 Credits		0.00	1

	responsibly sourced.	
Comments		
WASTE	Section Weighting: 3%	Indicative Section Score 1.80%
Was 01 Household Waste		
No. of BREEAM credits available 2	Available contr	ribution to overall score 1.20%
No. of BREEAM innovation credits 0	Minimu	um Standards applicable No
Assessment Criteria		Indicative Credits
Where compliant recycling and composting facilities a	re provided, up to two credits may be awarded as follows	
	First Credit - Recycling Facilities	
Scenario	Internal recycling storage requirer	ements
	3 internal recycling containers provided where recy	ycling is not sorted post
	collection	
	1 internal recycling container provided where rec	cycling is sorted post
Compliant collection scheme in place		
	conection	
	Minimum 30 litre total capacity, no single container	less than 7 litre capacity
	Dedicated position in accordance with com	
No compliant collection scheme in pla	ce <u>3 internal recycling containers pro</u>	
No adequate external storage	Minimum 60 litre total capacit	
	Dedicated position in accordance with com	
No compliant collection scheme in pla	ce <u>3 internal recycling containers pro</u> Minimum 30 litre total capacity, no single container	
Adequate external storage provided	Dedicated position in accordance with com	

Second credit - Com	posting facilities
With external space	Without external space
Where a composting service or facility is provided for	Where a composting service or facility is
green/garden waste	provided for kitchen waste
Where a composting service or facility is provided for kitchen waste	Where an interior container is provided for kitchen composting waste of at least 7 litres
Where an interior container is provided for kitchen	

	posting waste of at least 7 litres	
nments		
as 02 Refurbishment Site Waste Management No. of BREEAM credits available 3		1.80%
No. of BREEAM innovation credits 1	Minimum Standards applicable	No
sessment Criteria		Indicative Credi
· -	site waste management plan to be implemented as follows	3
Projects up to £100k		
Three Credits	Where waste generated through the refurbishment process is managed in	Indicative Innovat
	accordance with Checklist A-9	Credits Achieve
E	Where a compliant Level 1; Site Waste Management Plan (SWMP) is in	
Exemplary Credit	place	
Projects up to £300k		
	Where a compliant Level 1; Site Waste Management Plan (SWMP) is in	
Three Credits	place	
	V/hore a compliant Loval 2: Site Waste Management Blan (SW/MD) is in	
	Where a compliant Level 2; Site Waste Management Plan (SWMP) is in place	
	place	
Exemplary Credit	Non-hazardous construction waste generated by the dwellings	
	refurbishment meets or exceeds the resource efficiency benchmark	
	The percentage of non-hazardous construction waste and demolition waste	
	generated by the project has been diverted from landfill and meets or	
	exceeds the refurbishment & demolition waste diversion benchmarks	
Projects over £300k		
First Credit	Where a compliant Level 2; Site Waste Management Plan (SWMP) is in	
Management Plan	place	
	First credit achieved	
	Non-hazardous construction waste generated by the dwellings	
	refurbishment meets or exceeds the resource efficiency benchmark	

Second Credit Good Practice Waste Benchmarks	Amount of waste generated against £100,000 of project value is recorded in the SWMP
	Pre-refurbishment audit of the existing building is completed
	If demolition is included as part of the refurbishment programme, then the audit should also cover demolition materials
	Where the first two credits have been achieved achieved
Third Credit Best Practice Waste Benchmarks	Where Non-hazardous demolition waste generated by the dwellings refurbishment meets or exceeds the refurbishment & demolition waste diversion benchmarks
Exemplary Credit	Where non-hazardous construction waste generated by the dwellings refurbishment meets or exceeds the <i>exemplary level resource efficiency benchmark</i>
	Where Non-hazardous demolition waste generated by the dwellings refurbishment meets or exceeds the exemplary level diversion benchmarks

POLLUTION		Section Weighting: 6%	Indicative Section Scor	e 3.75 %
Pol 01 NOx Emissions				
No. of BREEAM credits available	3		Available contribution to overall score 2	.25%
No. of BREEAM innovation credits	0	1	Minimum Standards applicable	No
Assessment Criteria				Indicative Credits
	Ix emissions arising from	m the operation of space hea	ting and hot water systems for each refurbished	2
dwelling as follows:				
			Dry NOx Emissions	
		e Credit	≤100 mg/kWh (NOx class 4 boiler)	
		o Credits	≤70 mg/kWh (NOx class 5 boiler)	
	Thre	e Credits	≤40 mg/kWh	
Comments				
Pol 02 Surface Water Runoff				
No. of BREEAM credits available	3		Available contribution to overall score 2	.25%
No. of BREEAM innovation credits	1		Minimum Standards applicable	No
Assessment Criteria				Indicative Credits
-		are neutralised or where rune	off is reduced as a result of refurbishment, up to	
three credits can be awarded as follow				
R	equirements	Now bard standing areas, m	nuct he normeeble	_
		New hard standing areas m	lust be permeable	_
One Cre		If building on to previously	permeable area additional run-off must be managed on site	
Neutral Impact on S	Surface Water		-	
		Calculations should be carri	ed out by an appropriately qualified professional	
R	equirements			
			for One Credit has been achieved	
OB Second	Cradita		roof for rainfall depths up to 5 mm, have been managed on	
OR Second Credits	creuits	site using source control me		
Reducing Run Off F	rom Sita: Pacia	Include runoff from all exist	ing and new parts of the roof.	
Reducing Run-Off Fi	OM SILE: BASIC	An appropriately qualified p	professional should be used to design an appropriate drainag	e
		strategy for the site		
R	equirements			
	•			
		Where run-off as a result of	f the refurbishment is managed on site using source control	
				I

	An appropriately qualified professional should be used to design an appropriate drainage strategy for the site.
OR Three Credits	The peak rate of run-off as a result of the refurbishment for the 1 in 100 year event has been reduced by 75% from the existing site.
Reducing Run-Off From Site: Advanc	ed The total volume of run-off discharged into the watercourses and sewers as a result of the refurbishment, for a 1 in 100 year event of 6 hour duration has been reduced by 75%.
	An allowance for climate change must be included for all of the above calculations, in accordance with current best practice (PPS25, 2010).
Requirements	
	Where all run-off from the developed site is managed on site using source controlIndicative Innovation Credits Achieved
	The peak rate of run-off as a result of the refurbishment for the 1 in 1 year event is reduced to zero.
Exemplary Credit	The peak rate of run-off as a result of the refurbishment for the 1 in 100 year event is reduced to zero.
	There is no volume of run-off discharged into the watercourses and sewers as a result of the refurbishment, for a 1 in 100 year event of 6 hour duration.
	An allowance for climate change must be included for all of the above calculations, in accordance with current best practice (PPS25, 2010).
Comments	
Pol 03 Flooding No. of BREEAM credits available 2	
No. of BREEAM credits available 2 No. of BREEAM innovation credits 0	Available contribution to overall score 1.50% Minimum Standards applicable Yes
Assessment Criteria	Indicative Credits
	e, or where in a medium to high flood risk zone and a flood resilience/resistance 2
strategy has been implemented, up to two credits ca	
Minimum Standards	A minimum of two credits must be achieved for this issue at the Excellent and

Two Credits	Where a Flood Risk Assessment (FRA) has been carried out and the assessed dwellings are defined as having a low annual probability of flooding.
tion 2 - Medium / High Flood Risk	
Two Credits	Where a Flood Risk Assessment (FRA) has been carried out and the assessed dwellings are defined as having a medium or high annual probability of flooding.
	Two credits are awarded where as a result of the dwellings floor level or measures to keep water away the dwelling is defined as achieving avoidance from flooding by following Checklist A-10; Decision Strategy Flow Chart.
	Where avoidance is not possible, two credits are achieved where a full flood resilience/resistance strategy is implemented for the dwellings in accordance with recommendations made by a Suitably Qualified Building Professional