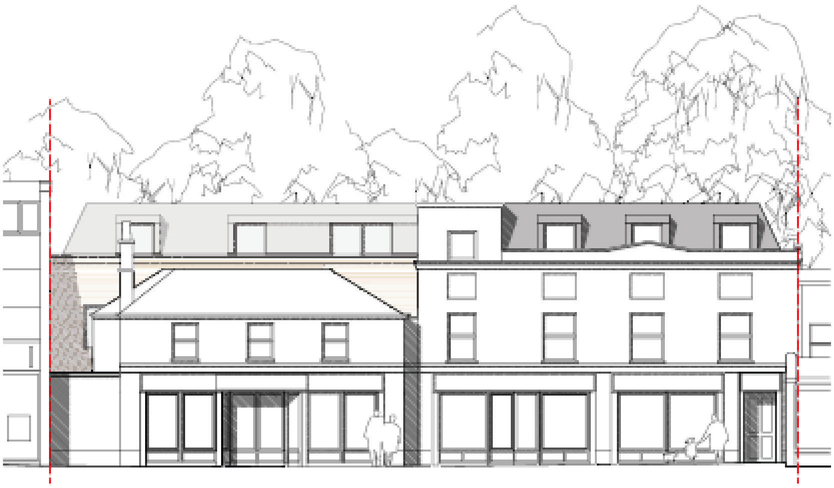
New & Refurbished Dwellings
179-181 High Street Hampton Hill
Hampton



Energy Conservation Statement

May 2016

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Revision Log

Draft Issue	20160525	Planning Report
Planning Submission	20160602	Planning Report

Issue

Our ref: X:\179HSHH_179-181 High Street, Hampton Hill\Reports\Sustainability

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 on-site 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.

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

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 CO_2 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**

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 CO_2 use is very low. Systems also require large, and often noisy units to be mounted externally.	**Rejected**

Micro Combined Heat and Power (CHP)	Micro 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. These systems are fairly cost prohibitive in comparison with other alternative renewable technologies.	**Rejected**

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 CO_2 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.

6.1 Options, Calculations and Results: Worst Case Apartment

Option	**Specification**	DER/TER Variance **BREGS L1A 2013 TARGET 0%**	**% reduction through renewables**
Apartment Base Case	DER U values in accordance with BRegs L1A 2013 minimum allowable limiting parameters -Roof U=0.2 W/m2K -External wall u =0.3 W/m^2K -Separating Floor u =0 W/m^2K -Separating Wall u =0 W/m^2K -Windows / Doors u =2.0 W/m^2K -Air tightness 10 m^3/hrm^2 -50% energy efficient lighting -Thermal bridging: default 0.15. -Instantaneous Combi boiler 88% efficient (SEDBUK 2009)	**48.06%**	**n/a**

Apartment Improved Case	Improved build ups/services chosen to reach BRegs L1A 2013 -Roof u =0.13 W/m^2K -External wall u =0.22 W/m^2K -Separating Floor u =0 W/m^2K -Separating Floor u =0 W/m^2K -Windows / Doors u =1.33 W/m^2K -Thermal bridging: 0.0241 calculated. -Air tightness: 4.5 m^3/hrm^2 -Instantaneous Combi boiler 89.1% efficient -75% energy efficient lighting	**-0.15%**	**0%**
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:

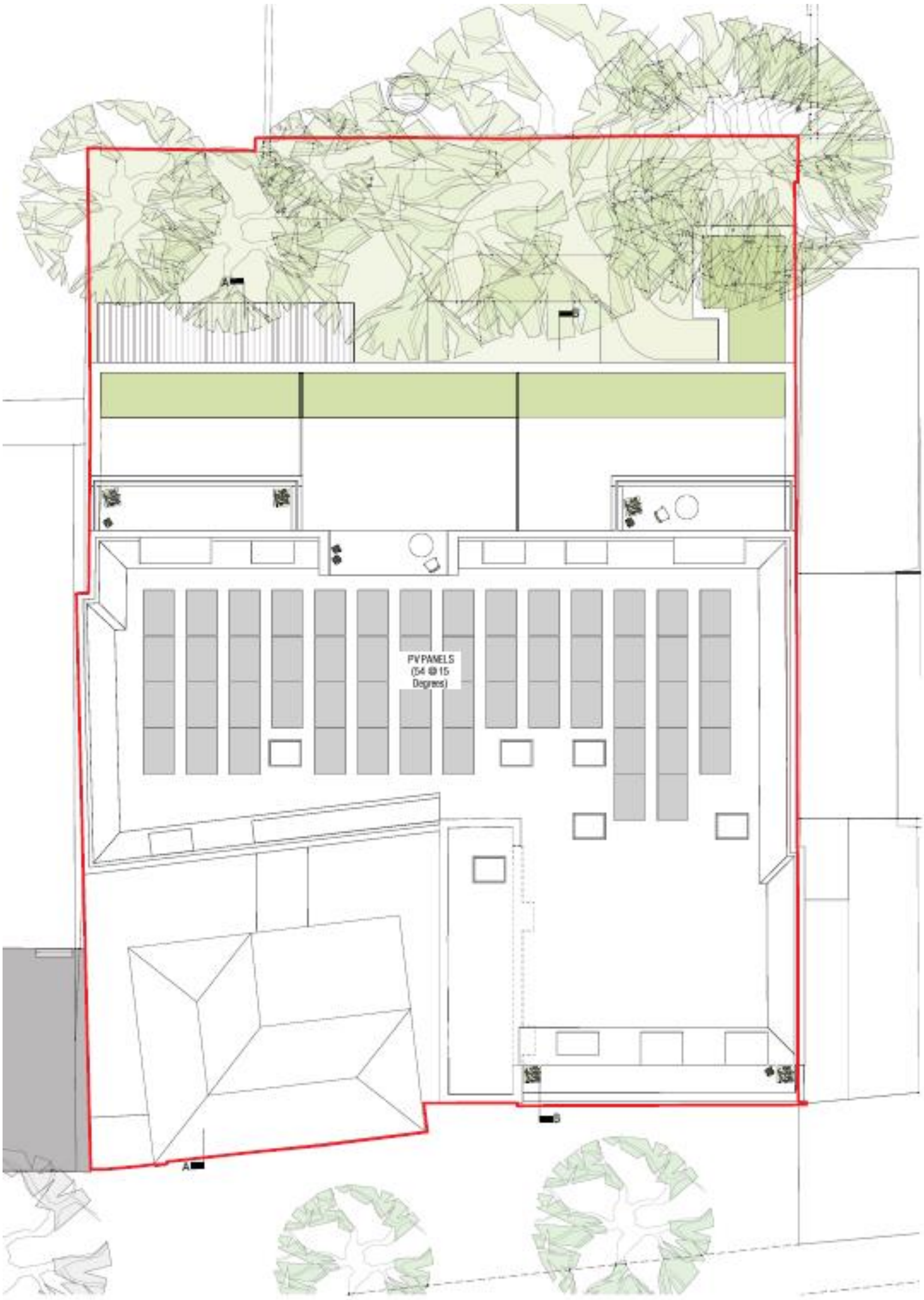

Fig 4. PV array location in relation to roof space

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. 5.4m^2 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 m^2

Energy requirement/m^2: 0.0175 kWp/m^2

Estimated PV array size for whole development to meet LBRuT 20% reduction in CO_2 emissions target:

Number of panels required –

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

Area of array - 1.6m^2 x 32 = 51.2 m^2

Cost of array - 51.2m^2 x £500/m^2 = **£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 CO_2 Emission Data

	Total $kgCO_2$/yr		
Unit	**Base Case**	**Improved Case**	**Proposed 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_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	C	B

Fig6. Table of CO_2 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): 179 - 181 High Street Hampton Hill, Hampton, TW12 1NL

Completed by: Andrew Alford

For Non-Residential
Size of development (m2): 540

For Residential
Number of dwellings: 10

1 MINIMUM COMPLIANCE (RESIDENTIAL AND NON-RESIDENTIAL)

Energy Assessment

Has an energy assessment been submitted that demonstrates the expected energy and carbon dioxide emissions saving from energy efficiency and renewable energy measures, including the feasibility of CHP/CCHP and community heating systems? If yes, please tick. √

Carbon Dioxide emissions reduction

What is the carbon dioxide emissions reduction against a Building Regulations Part L (2013) baseline: 35%

Policy DM SD 1 and London Plan Policy 5.2 (2015) require a 35% reduction in CO_2 emissions beyond Building Regulations 2013.

Percentage of **total** site CO2 emissions saved through renewable energy installation? 20

1A MINIMUM POLICY COMPLIANCE (NON-RESIDENTIAL AND DOMESTIC REFURBISHMENT)

Please check the Guidance Section of this SPD for the policy requirements

Environmental Rating of development:

Non-Residential new-build (100sqm or more)

BREEAM Level	Please Select	Have you attached a pre-assessment to support this?	☐

Extensions and conversions for residential dwellings

BREEAM Domestic Refurbishment	Excellent	Have you attached a pre-assessment to support this?	☑

Extensions and conversions for non-residential buildings

BREEAM Level	Excellent	Have you attached a pre-assessment to support this?	☑

Score awarded for Environmental Rating: **Subtotal** 16

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*

Subtotal 1

2. ENERGY USE AND POLLUTION

2.1 Need 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 providng/improving insulation and living roofs and walls	☑ 2
	Reduce heat entering a building through shading	☐ 3
	Exposed thermal mass and high ceilings	☐ 4
	Passive ventilation	☐ 3
	Mechanical ventilation with heat recovery	☑ 1
	Active cooling systems, i.e. Air Conditioning Unit	☐ 0

2.2 Heat 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	☐ 6
	Connection to existing heating or cooling networks powered by gas or electricity	☐ 5
	Site wide CHP network powered by renewable energy	☐ 4
	Site wide CHP network powered by gas	☐ 3
	Communal heating and cooling powered by renewable energy	☐ 2
	Communal heating and cooling powered by gas or electricity	☐ 1
	Individual heating and cooling	☑ 0

2.3 Pollution: Air, Noise and Light

a.	Does the development plan to implement reduction strategies for dust emissions from construction sites?	☑ 2
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 information. If the proposed boiler is of a qualifying size, you may need to completed the information request form found on the Richmond website.	☐ -
c.	Please tick only one option below	
	Has the development taken measures to reduce existing noise and enhance the existing soundscape of the site?	☐ 3
	Has the development taken care to not create any new noise generation/transmission issues in its intended operation?	☑ 1
d.	Has the development taken measures to reduce light pollution impacts on character, residential amenity and biodiversity?	☐ 3
e.	Have you attached a Lighting Pollution Report?	☐ -

Subtotal 6

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*

c. **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) ☑ *2*
If so, for how many bicycles? 10
Is this shown on the site plans? ☑ *-*

f. Will the development create or improve links with local and wider transport networks? If yes, please provide details. ☐ *2*

Subtotal 7

Please give any additional relevant comments to the Transport Section below

Please see Sustainability Strategy and Transport Statement.

4 BIODIVERSITY

4.1 Minimising the threat to biodiversity from new buildings, lighting, hard surfacing and people

a. Does your development involve the loss of an ecological feature or habitat, including a loss of garden or other green space? (Indicate if yes) ☑ -2

If so, please state how much in sqm? 319 sqm

b. 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? (Indicate if yes) -☑

c. Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes) -☐

d. Please indicate which features and/or habitats that your development will incorporate to improve on site biodiversity:

Feature	Score	Selected		Area provided (sqm)
Pond, reedbed or extensive native planting	6	☐	Area provided:	
An extensive green roof	5	☑	Area provided:	45
An intensive green roof	4	☐	Area provided:	
Garden space	4	☑	Area provided:	134
Additional native and/or wildlife friendly planting to peripheral areas	3	☑	Area provided:	30
Additional planting to peripheral areas	2	☑	Area provided:	
A living wall	2	☐	Area provided:	
Bat boxes	0.5	☑		
Bird boxes	0.5	☑		
Other	0.5	☑		

Subtotal **13.5**

Please give any additional relevant comments to the Biodiversity Section below

Additional tree planting along High Street to continue existing 'avenue'

5 FLOODING AND DRAINAGE

5.1 Mitigating the risks of flooding and other impacts of climate change in the borough

a. Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) ☐ -2

Have you submitted a Flood Risk Assessment? (Indicate if yes) ☐ -

b. Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick all that apply)

Measure	Selected	Score
Store rainwater for later use	☑	5
Use of infiltration techniques such as porous surfacing materials to allow drainage on-site	☑	3
Attenuate rainwater in ponds or open water features	☐	4
Store rainwater in tanks for gradual release to a watercourse	☐	3
Discharge rainwater directly to watercourse	☐	2
Discharge rainwater to surface water drain	☑	1
Discharge rainwater to combined sewer	☐	0

c. Please give the change in area of permeable surfacing which will result from your development proposal: -319 sqm

Please provide details of the permeable surfacing below

please represent a loss in permeable area as a negative number

Subtotal 9

Please give any additional relevant comments to the Flooding and Drainage Section below

6 IMPROVING RESOURCE EFFICIENCY

6.1 Reduce waste generated and amount disposed of by landfill though increasing level of re-use and recycling

a.	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]*	☑	*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 %	
b.	Does your site have any contaminated land?	☐	*1*
	Have you submitted an assessment of the site contamination?	☐	*2*
	Are plans in place to remediate the contamination?	☐	*2*
	Have you submitted a remediation plan?	☐	*1*
	Are plans in place to include composting on site?	☐	*1*

6.2 Reducing levels of water waste

a.	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	☑	*1*
	Use of water efficient A or B rated appliances	☑	*1*
	Rainwater harvesting for internal use	☐	*4*
	Greywater systems	☐	*4*
	Fit a water meter	☑	*1*

Subtotal 4

Please give any additional relevant comments to the Improving Resource Efficiency Section below

7 ACCESSIBILITY

7.1 Ensure flexible adaptable and long-term use of structures

a. **If the development is residential,** will it meet the requirements of the nationally described space standard for internal space and layout? ☑ *1*

If the standards are not met, in the space below, please provide details of the functionality of the internal space and layout

AND

b. **If the development is residential**, will it meet Building Regulation Requirement M4 (2) 'accessible and adaptable dwellings'? ☐ *2*

If this is not met, in the space below, please provide details of any accessibility measures included in the development.

For major residential developments, are 10% or more of the units in the development to Building Regulation Requirement M4 (3) 'wheelchair user dwellings'? ☐ *1*

OR

c. **If the development is non-residential,** does it comply with requirements included in Richmond's Design for Maximum Access SPG ☐ *2*

Please provide details of the accessibility measures specified in the Maximum Access SPG that will be included in the development

Subtotal 1

Please give any additional relevant comments to the Design Standards and Accessibility Section below

LBRUT Sustainable Construction Checklist- Scoring Matrix for *New Construction* **(Non-Residential and domestic refurb)**

TOTAL ***57.5***

Score	Rating	Significance
80 or more	*A+*	Project strives to achieve highest standard in energy efficient sustainable development
71-79	*A*	Makes a major contribution towards achieving sustainable development in Richmond
51-70	*B*	Helps to significantly improve the Borough's stock of sustainable developments
36-50	*C*	Minimal effort to increase sustainability beyond general compliance
35 or less	*FAIL*	Does not comply with SPD Policy

LBRUT Sustainable Construction Checklist- Scoring Matrix for New Construction **Residential new-build**

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	*A*	Makes a major contribution towards achieving sustainable development in Richmond
35-54	*B*	Helps to significantly improve the Borough's stock of sustainable developments
20-34	*C*	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

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	Assessor number	1003
Client		Last modified	01/06/2016
Address	179-181 High Street, Hampton Hill, TW12 1NL		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		52.00	(1a)	x	2.40	(2a)	=	124.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.00	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		124.80	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	2	x 10 =	20	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.16	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.66	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.56	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 shelter and wind factor) (21) x (22a)m	0.72	0.70	0.69	0.62	0.60	0.53	0.53	0.52	0.56	0.60	0.63	0.66	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.76	0.75	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 - enter (24a) or (24b) or (24c) or (24d) in (25)	0.76	0.75	0.74	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.70	0.72	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m^2	Openings m^2	Net area A, m^2		U-value W/m^2K		A x U W/K	κ-value, $kJ/m^2.K$	A x κ, kJ/K	
Roof window			0.80	x	1.85	=	1.48			(27a)
Window			5.36	x	1.85	=	9.93			(27)
External wall			36.34	x	0.30	=	10.90			(29a)
Party wall			41.10	x	0.00	=	0.00			(32)
Roof			94.03	x	0.20	=	18.81			(30)
Total area of external elements ∑A, m^2			136.53							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.12	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m^2K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.48	(36)
Total fabric heat loss	(33) + (36) =	61.59	(37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 coefficient, W/K (37)m + (38)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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)1...12/12 = 90.03 (39)

Heat loss parameter (HLP), W/m^2K (39)m ÷ (4)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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)1...12/12 = 1.73 (40)

Number of days in month (Table 1a)

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

Assumed occupancy, N	1.75	(42)
Annual average hot water usage in litres 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 in litres per day for each month Vd,m = factor from Table 1c x (43)	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 water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (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 loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m 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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	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 calculated using Appendix G or 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 water heater for each month (kWh/month) (62)m + (63)m

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 = 1791.69 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)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 gains

	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 (calculated in Appendix L, equation L9 or L9a), also see Table 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 Appendix L, equation L13 or L13a), also see 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 (calculated in Appendix L, equation L15 or L15a), 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 gains (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. evaporation (Table 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 gains (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 gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	1.00	x	0.80	x	19.64	x 0.9 x	0.72	x	0.70	=	7.13	(80)
West	0.54	x	5.36	x	19.64	x 0.9 x	0.72	x	0.70	=	25.79	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	32.91	64.38	106.03	154.64	189.52	194.01	184.70	158.66	123.32	76.40	41.04	27.07	(83)
Total gains - internal and solar (73)m + (83)m	466.84	493.46	517.42	539.85	548.79	530.62	508.80	490.77	471.24	450.67	443.81	450.57	(84)

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	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.93	0.91	0.87	0.80	0.70	0.58	0.61	0.76	0.87	0.92	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	17.87	18.10	18.56	19.22	19.87	20.44	20.73	20.70	20.27	19.45	18.58	17.85	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.48	19.49	19.49	19.52	19.52	19.55	19.55	19.55	19.54	19.52	19.51	19.50	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.93	0.91	0.89	0.84	0.75	0.61	0.44	0.47	0.68	0.84	0.91	0.93	(89)

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

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 fraction — Living area ÷ (4) = 0.52 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

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

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 requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	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, ηmGm, W (94)m x (84)m	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 average external temperature from Table 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 mean internal temperature, Lm, W [(39)m 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 requirement, kWh/month 0.024 x [(97)m - (95)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)1...5, 10...12 = 3265.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 62.79 (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)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		84.00	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	683.35	571.44	528.60	365.44	233.30	0.00	0.00	0.00	0.00	321.18	500.48	683.38

∑(211)1...5, 10...12 = 3887.16 (211)

Water heating

Efficiency of water heater	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 fuel, kWh/month	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

Space heating fuel - main system 1		3887.16	
Water heating fuel		2260.92	
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)

Electricity for lighting (Appendix L)		345.13	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6568.22	(238)

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

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3887.16	x	0.22	=	839.63	(261)
Water heating	2260.92	x	0.22	=	488.36	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1327.99	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	345.13	x	0.52	=	179.12	(268)
Total CO_2, kg/year				(265)...(271) =	1546.04	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	29.73	(273)
EI value					78.64	
EI rating (section 14)					79	(274)
EI band					C	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3887.16	x	1.22	=	4742.34	(261)
Water heating	2260.92	x	1.22	=	2758.32	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7500.66	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	345.13	x	3.07	=	1059.56	(268)
Primary energy kWh/year					8790.47	(272)
Dwelling primary energy rate kWh/m2/year					169.05	(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	Assessor number	1003
Client		Last modified	26/05/2016
Address	179-181 High Street, Hampton Hill, TW12 1		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		52.00	(1a)	x	2.40	(2a)	=	124.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.00	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		124.80	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.16	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.50	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.39	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 shelter and wind factor) (21) x (22a)m	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 change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	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 - enter (24a) or (24b) or (24c) or (24d) in (25)	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)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, 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 external elements ∑A, m²			136.53							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	27.65	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		3.29	(36)
Total fabric heat loss	(33) + (36) =	30.94	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (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 coefficient, 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)1...12/12 =												54.20	(39)
Heat loss parameter (HLP), W/m²K (39)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)1...12/12 =												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 heating energy requirement

Assumed occupancy, N	1.75	(42)
Annual average hot water usage in litres 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 in litres per day for each month Vd,m = factor from Table 1c x (43)	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 water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (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 loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m 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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)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 input calculated using Appendix G or 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)

Flue gas heat recovery system 1 input (Appendix G1)

-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 water heater for each month (kWh/month) (62)m + (63)m

143.49	126.40	133.22	120.50	119.13	107.58	103.46	113.34	113.08	125.23	130.86	139.96

∑(64)1...12 = 1476.25 (64)

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

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 gains

	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 (calculated in Appendix L, equation L9 or L9a), also see Table 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 Appendix L, equation L13 or L13a), also see 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 (calculated in Appendix L, equation L15 or L15a), 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 gains (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. evaporation (Table 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 gains (Table 5)	68.13	66.38	62.75	57.81	54.60	50.09	46.25	51.17	52.91	58.03	63.80	66.39	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	429.45	424.63	406.99	380.86	354.95	332.32	319.79	327.78	343.54	369.84	398.31	419.02	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	1.00	x	0.80	x	19.64	x 0.9 x	0.72	x	0.80	=	8.15	(80)
West	0.54	x	5.36	x	19.64	x 0.9 x	0.72	x	0.70	=	25.79	(80)

Solar gains in watts ∑(74)m...(82)m

33.93	66.38	109.31	159.42	195.38	200.01	190.42	163.56	127.13	78.76	42.31	27.90	(83)

Total gains - internal and solar (73)m + (83)m

463.38	491.00	516.30	540.28	550.33	532.33	510.21	491.35	470.67	448.60	440.62	446.92	(84)

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	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.90	0.87	0.80	0.70	0.56	0.43	0.46	0.64	0.81	0.89	0.92	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.24	19.43	19.77	20.21	20.58	20.84	20.94	20.93	20.76	20.29	19.71	19.21	(87)

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

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 for gains for rest of dwelling n2,m

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

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 fraction — Living area ÷ (4) = 0.52 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

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

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)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for 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)
Useful gains, ηmGm, W (94)m x (84)m	412.74	427.63	429.92	412.07	362.10	272.75	191.82	199.15	278.98	345.63	378.89	401.43	(95)
Monthly average external temperature from Table 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 mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	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 requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	283.98	229.70	199.47	123.28	65.54	0.00	0.00	0.00	0.00	111.03	199.61	289.27	

∑(98)1...5, 10...12 = 1501.89 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 28.88 (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)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		90.00	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	315.53	255.23	221.63	136.98	72.82	0.00	0.00	0.00	0.00	123.37	221.79	321.42

∑(211)1...5, 10...12 = 1668.76 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	88.86	88.80	88.65	88.34	87.84	86.70	86.70	86.70	86.70	88.22	88.66	88.90	(217)
Water heating fuel, kWh/month	161.47	142.34	150.28	136.41	135.61	124.09	119.33	130.72	130.43	141.96	147.59	157.44	

∑(219a)1...12 = 1677.67 (219)

Annual totals

Space heating fuel - main system 1	1668.76
Water heating fuel	1677.67

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)
Electricity for lighting (Appendix L)		343.25	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3764.68	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1668.76	x	3.48	x 0.01 =	58.07	(240)
Water heating	1677.67	x	3.48	x 0.01 =	58.38	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	343.25	x	13.19	x 0.01 =	45.27	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	291.62	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.26	(257)
SAP value	82.39	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	1668.76	x	0.22	=	360.45	(261)
Water heating	1677.67	x	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 CO_2 emission rate				(272) ÷ (4) =	18.08	(273)
EI value					87.02	
EI rating (section 14)					87	(274)
EI band					B	

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 Andrew Alford	Assessor number	1003
Client		Last modified	25/05/2016
Address	179-181 High Street, Hampton Hill, TW12 1		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		52.00	(1a)	x	2.40	(2a)	=	124.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.00	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			124.80	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.16	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.50	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.39	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 shelter and wind factor) (21) x (22a)m	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 change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	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 - enter (24a) or (24b) or (24c) or (24d) in (25)	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)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, 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 external elements ∑A, m²			136.53							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	27.65	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		3.29	(36)
Total fabric heat loss	(33) + (36) =	30.94	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (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 coefficient, 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)1...12/12 =												54.20	(39)
Heat loss parameter (HLP), W/m²K (39)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)1...12/12 =												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 heating energy requirement

Assumed occupancy, N	1.75	(42)
Annual average hot water usage in litres 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 in litres per day for each month Vd,m = factor from Table 1c x (43)	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 water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (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 loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m 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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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 input calculated using Appendix G or 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)
Flue gas heat recovery system 1 input (Appendix G1)	-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 water heater for each month (kWh/month) (62)m + (63)m	143.46	126.38	133.20	120.48	119.12	107.58	103.46	113.34	113.08	125.20	130.83	139.93	

∑(64)1...12 = 1476.06 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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 gains

	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 (calculated in Appendix L, equation L9 or L9a), also see Table 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 Appendix L, equation L13 or L13a), also see 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 (calculated in Appendix L, equation L15 or L15a), 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 gains (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. evaporation (Table 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 gains (Table 5)	68.13	66.38	62.75	57.81	54.60	50.09	46.25	51.17	52.91	58.03	63.80	66.39	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	419.73	416.00	399.97	375.54	350.98	328.96	316.17	323.07	337.22	361.81	388.94	409.03	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	1.00	x	0.80	x	19.64	x 0.9 x	0.72	x	0.80	=	8.15	(80)
West	0.54	x	5.36	x	19.64	x 0.9 x	0.72	x	0.70	=	25.79	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	33.93	66.38	109.31	159.42	195.38	200.01	190.42	163.56	127.13	78.76	42.31	27.90	(83)
Total gains - internal and solar (73)m + (83)m	453.66	482.37	509.28	534.97	546.36	528.97	506.58	486.64	464.35	440.57	431.25	436.93	(84)

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	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.90	0.87	0.80	0.70	0.56	0.43	0.47	0.65	0.82	0.90	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.22	19.41	19.75	20.20	20.58	20.84	20.94	20.93	20.75	20.28	19.69	19.18	(87)

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

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 for gains for rest of dwelling n2,m

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

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 fraction — Living area ÷ (4) = 0.52 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

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

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)

8. Space heating requirement

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

Utilisation factor 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, ηmGm, W (94)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 external temperature from Table 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 mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

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 requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

288.01	232.73	201.86	124.64	66.22	0.00	0.00	0.00	0.00	113.23	203.01	293.53	

∑(98)1...5, 10...12 = 1523.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 29.29 (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)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		90.00	(206)

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

Space heating fuel (main system 1), kWh/month

320.01	258.59	224.29	138.49	73.57	0.00	0.00	0.00	0.00	125.81	225.57	326.14	

∑(211)1...5, 10...12 = 1692.47 (211)

Water heating

Efficiency of water heater

88.88	88.81	88.66	88.35	87.85	86.70	86.70	86.70	86.70	88.24	88.68	88.91	(217)

Water heating fuel, kWh/month

161.42	142.31	150.24	136.37	135.59	124.09	119.33	130.72	130.43	141.89	147.54	157.39	

∑(219a)1...12 = 1677.31 (219)

Annual totals

Space heating fuel - main system 1	1692.47
Water heating fuel	1677.31

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)
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) + (232)...(237b) =	2920.86	(238)

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

	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-CHP

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	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	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	x	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 CO_2 emission rate				(272) ÷ (4) =	9.52	(273)
EI value					93.16	
EI rating (section 14)					93	(274)
EI band					A	

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

	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 Andrew Alford	Assessor number	1003
Client		Last modified	25/05/2016
Address	179-181 High Street, Hampton Hill, TW12 1NW		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		54.70	(1a)	x	2.26	(2a)	=	123.62	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	54.70	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			123.62	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	2	x 40 =	80	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	80	÷ (5) =	0.65	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		1.15	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.89	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 shelter and wind factor) (21) x (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 change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	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 - enter (24a) or (24b) or (24c) or (24d) in (25)	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)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			5.79	x	2.68	=	15.51			(27)
External wall			62.74	x	2.50	=	156.85			(29a)
Roof			38.50	x	2.60	=	100.10			(30)
Roof			16.20	x	1.90	=	30.78			(30)
Total area of external elements ∑A, m²			123.23							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	303.24	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		18.48	(36)
Total fabric heat loss	(33) + (36) =	321.72	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (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 coefficient, W/K (37)m + (38)m	367.97	367.06	366.15	361.63	360.75	356.67	356.67	355.92	358.24	360.75	362.53	364.34	
Average = ∑(39)1...12/12 =												361.56	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	6.73	6.71	6.69	6.61	6.60	6.52	6.52	6.51	6.55	6.60	6.63	6.66	
Average = ∑(40)1...12/12 =												6.61	(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 heating energy requirement

Assumed occupancy, N	1.83	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	77.63	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	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 water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	126.63	110.75	114.29	99.64	95.61	82.50	76.45	87.73	88.77	103.46	112.93	122.64	
∑(45)1...12 =												1221.40	(45)
Distribution loss 0.15 x (45)m	18.99	16.61	17.14	14.95	14.34	12.38	11.47	13.16	13.32	15.52	16.94	18.40	(46)
Water storage loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m 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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	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)

Solar DHW input calculated using Appendix G or 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 water heater for each month (kWh/month) (62)m + (63)m

177.59	156.78	165.25	148.95	146.56	131.82	127.41	138.69	138.09	154.42	162.25	173.60	

∑(64)1...12 = 1821.40 (64)

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

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 gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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 (calculated in Appendix L, equation L13 or L13a), also see Table 5	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 (calculated in Appendix L, equation L15 or L15a), 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	(69)
Pump and fan gains (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. evaporation (Table 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 gains (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 gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	479.83	471.47	448.12	415.63	384.47	358.98	346.80	358.40	379.82	412.49	446.28	469.80	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	1.00	x	2.97	x	36.79	x 0.9 x	0.85	x	0.70	=	58.52	(79)
NorthEast	0.30	x	1.98	x	11.28	x 0.9 x	0.85	x	0.70	=	3.59	(75)
SouthEast	0.30	x	0.84	x	36.79	x 0.9 x	0.72	x	0.70	=	4.21	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 - internal and solar (73)m + (83)m	546.15	585.62	607.47	618.38	616.41	591.37	569.96	559.46	554.15	539.50	525.93	526.41	(84)

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	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.98	0.98	0.97	0.95	0.92	0.88	0.89	0.94	0.97	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	16.33	16.55	17.06	17.81	18.66	19.52	20.09	20.03	19.34	18.27	17.19	16.30	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.97	0.97	0.95	0.92	0.82	0.59	0.64	0.86	0.95	0.97	0.98	(89)

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

14.24	14.46	14.97	15.72	16.56	17.38	17.86	17.82	17.22	16.18	15.10	14.21	(90)

Living area fraction — Living area ÷ (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.96	0.96	0.94	0.91	0.84	0.72	0.75	0.87	0.93	0.96	0.97	(94)
Useful gains, ηmGm, 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	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 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	2558.50	2186.67	2105.08	1578.27	1116.37	0.00	0.00	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)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		84.00	(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	1878.90	1329.02	0.00	0.00	0.00	0.00	1605.46	2315.47	3050.05	

∑(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	186.10	194.94	208.24	

∑(219a)1...12 = 2259.65 (219)

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)

Electricity for lighting (Appendix L)	570.90	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	21239.50	(238)

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

	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 including 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 including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/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)
EI value					40.30	
EI rating (section 14)					40	(274)
EI band					E	

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

	Energy kWh/year		Primary factor		Primary Energy 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	Assessor number	1003
Client		Last modified	01/06/2016
Address	179-181 High Street, Hampton Hill, TW12 1NW		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		54.70	(1a)	x	2.26	(2a)	=	123.62	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	54.70	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			123.62	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		2	x 40 =	80	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	80	÷ (5) =	0.65	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		1.15	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.89	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 shelter and wind factor) (21) x (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 change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	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 - enter (24a) or (24b) or (24c) or (24d) in (25)	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)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, 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 external elements ∑A, m²			123.23							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.94	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.82	(36)
Total fabric heat loss	(33) + (36) =	39.76	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (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 coefficient, 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	
Average = ∑(39)1...12/12 =												79.59	(39)
Heat loss parameter (HLP), W/m²K (39)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	
Average = ∑(40)1...12/12 =												1.46	(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 heating energy requirement

Assumed occupancy, N	1.83	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	77.63	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	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 water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	126.63	110.75	114.29	99.64	95.61	82.50	76.45	87.73	88.77	103.46	112.93	122.64	
∑(45)1...12 =												1221.40	(45)
Distribution loss 0.15 x (45)m	18.99	16.61	17.14	14.95	14.34	12.38	11.47	13.16	13.32	15.52	16.94	18.40	(46)
Water storage loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m 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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	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)

Solar DHW input calculated using Appendix G or 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)

Flue gas heat recovery system 1 input (Appendix G1)

-21.27	-18.61	-18.86	-16.24	-14.28	-10.93	-10.40	-11.55	-11.57	-16.46	-18.51	-20.75	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

156.32	138.17	146.38	132.72	132.29	120.89	117.01	127.14	126.52	137.95	143.74	152.85

∑(64)1...12 = 1631.97 (64)

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

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 gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 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 Appendix L, equation L13 or L13a), also see Table 5													
	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 (calculated in Appendix L, equation L15 or L15a), 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	(69)
Pump and fan gains (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. evaporation (Table 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 gains (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 gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	439.42	435.58	418.93	393.54	367.95	345.04	331.73	338.82	353.53	379.11	407.32	428.26	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	1.00	x	2.97	x	36.79	x 0.9 x	0.85	x	0.70	=	58.52	(79)
NorthEast	0.30	x	1.98	x	11.28	x 0.9 x	0.85	x	0.70	=	3.59	(75)
SouthEast	0.30	x	0.84	x	36.79	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	202.75	231.94	232.39	223.16	201.06	174.33	127.01	79.64	56.61	(83)

Total gains - internal and solar (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 internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see 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 temp of living area T1 (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 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)

Utilisation factor for gains for rest of dwelling 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 temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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 — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

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 the mean internal temperature from Table 4e where appropriate

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 requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for 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, W (94)m x (84)m	497.26	536.26	555.32	550.41	506.31	389.37	273.13	283.10	401.19	467.05	473.46	477.89	(95)
Monthly average external temperature from Table 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 mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1254.61	1204.82	1080.27	864.58	658.69	425.77	280.22	292.31	467.83	729.08	988.28	1214.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	563.47	449.27	390.56	226.20	113.37	0.00	0.00	0.00	0.00	194.95	370.68	548.01	

∑(98)1...5, 10...12 = 2856.51 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 52.22 (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)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		90.00	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	626.08	499.19	433.96	251.34	125.97	0.00	0.00	0.00	0.00	216.61	411.86	608.90

∑(211)1...5, 10...12 = 3173.90 (211)

Water heating

Efficiency of water heater	87.60	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, kWh/month	178.46	158.08	168.25	154.35	156.99	151.30	146.45	159.12	158.35	161.31	165.35	174.51	

∑(219a)1...12 = 1932.52 (219)

Annual totals

Space heating fuel - main system 1	3173.90	
Water heating fuel	1932.52	
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)
Electricity for lighting (Appendix L)				285.45	(232)
Total delivered energy for all uses			(211)...(221) + (231) + (232)...(237b) =	5466.88	(238)

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/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)
Total CO_2, kg/year				(265)...(271) =	1290.06	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	23.58	(273)
EI value					82.66	
EI rating (section 14)					83	(274)
EI band					B	

13a. Primary energy - individual heating systems including 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)

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	Assessor number	1003
Client		Last modified	25/05/2016
Address	179-181 High Street, Hampton Hill, TW12 1NW		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		54.70	(1a)	x	2.26	(2a)	=	123.62	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	54.70	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			123.62	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	2	x 40 =	80	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	80	÷ (5) =	0.65	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		1.15	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.89	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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 shelter and wind factor) (21) x (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 change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	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 - enter (24a) or (24b) or (24c) or (24d) in (25)	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)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, 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 external elements ∑A, m²			123.23							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.94	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.82	(36)
Total fabric heat loss	(33) + (36) =	39.76	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (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 coefficient, 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	
Average = ∑(39)1...12/12 =												79.59	(39)
Heat loss parameter (HLP), W/m²K (39)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	
Average = ∑(40)1...12/12 =												1.46	(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 heating energy requirement

Assumed occupancy, N	1.83	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	77.63	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	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 water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	126.63	110.75	114.29	99.64	95.61	82.50	76.45	87.73	88.77	103.46	112.93	122.64	
∑(45)1...12 =												1221.40	(45)
Distribution loss 0.15 x (45)m	18.99	16.61	17.14	14.95	14.34	12.38	11.47	13.16	13.32	15.52	16.94	18.40	(46)
Water storage loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m 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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	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)

Solar DHW input calculated using Appendix G or 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)

Flue gas heat recovery system 1 input (Appendix G1)

-21.27	-18.61	-18.86	-16.24	-14.28	-10.93	-10.40	-11.55	-11.57	-16.46	-18.51	-20.75	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

156.32	138.17	146.38	132.72	132.29	120.89	117.01	127.14	126.52	137.95	143.74	152.85

∑(64)1...12 = 1631.97 (64)

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

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 gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	109.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 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 Appendix L, equation L13 or L13a), also see Table 5	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 (calculated in Appendix L, equation L15 or L15a), 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	(69)
Pump and fan gains (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. evaporation (Table 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 gains (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 gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	439.42	435.58	418.93	393.54	367.95	345.04	331.73	338.82	353.53	379.11	407.32	428.26	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	1.00	x	2.97	x	36.79	x 0.9 x	0.85	x	0.70	=	58.52	(79)
NorthEast	0.30	x	1.98	x	11.28	x 0.9 x	0.85	x	0.70	=	3.59	(75)
SouthEast	0.30	x	0.84	x	36.79	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	202.75	231.94	232.39	223.16	201.06	174.33	127.01	79.64	56.61	(83)

Total gains - internal and solar (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 internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see 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 temp of living area T1 (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 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)

Utilisation factor for gains for rest of dwelling n2,m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 the mean internal temperature from Table 4e where appropriate

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for 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, W (94)m x (84)m	497.26	536.26	555.32	550.41	506.31	389.37	273.13	283.10	401.19	467.05	473.46	477.89	(95)
Monthly average external temperature from Table 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 mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1254.61	1204.82	1080.27	864.58	658.69	425.77	280.22	292.31	467.83	729.08	988.28	1214.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	563.47	449.27	390.56	226.20	113.37	0.00	0.00	0.00	0.00	194.95	370.68	548.01	

∑(98)1...5, 10...12 = 2856.51 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 52.22 (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)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		90.00	(206)

Space heating fuel (main system 1), kWh/month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
626.08	499.19	433.96	251.34	125.97	0.00	0.00	0.00	0.00	216.61	411.86	608.90

∑(211)1...5, 10...12 = 3173.90 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	87.60	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, kWh/month	178.46	158.08	168.25	154.35	156.99	151.30	146.45	159.12	158.35	161.31	165.35	174.51	

∑(219a)1...12 = 1932.52 (219)

Annual totals

Space heating fuel - main system 1		3173.90
Water heating fuel		1932.52
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)
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-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)
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-CHP

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	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	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	x	0.52	=	-418.77	(269)
Total CO_2, kg/year			(265)...(271) =		871.29	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		15.93	(273)
EI value					88.29	
EI rating (section 14)					88	(274)
EI band					B	

13a. Primary energy - individual heating systems including 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)

Energy saving/generation technologies						
Electricity generated - PVs	-806.88	x	3.07	=	-2477.13	(269)
Primary energy kWh/year					4859.30	(272)
Dwelling primary energy rate kWh/m2/year					88.84	(273)

Appendix B – BREEAM Assesment

BREEAM UK Domestic Refurbishment 2014 Pre-Assessment Estimator v0.1

BREEAM UK

This assessment and indicative BREEAM rating is not a formal certified BREEAM assessment or rating and must not be communicated as such. The score presented is indicative of a dwelling's potential performance and is based on a simplified pre-formal BREEAM assessment and unverified commitments given at an early stage in the design process.

Building name	179-181 High Street Hampton Hill
Indicative building score (%)	74.81%
Indicative BREEAM rating	BREEAM Excellent

Minimum Standards	Pass	Good	Very Good	Excellent	Outstanding
Ene 02	✓	✓	✓	✓	✓
Wat 01	✓	✓	✓	✓	✗
Hea 05	✓	✓	✓	✓	✓
Hea 06	✓	✓	✓	✓	✓
Pol 03	✓	✓	✓	✓	✓
Mat 02	✓	✓	✓	✓	✓

Management | Health & Wellbeing | Energy | Water | Materials | Waste | Pollution

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 contribution to overall score	3.27%
No. of BREEAM innovation credits	0	Minimum Standards applicable:	No

Assessment Criteria

Where a Home Users Guide be provided to all dwellings, covering all issues set out in the 'Users Guide Contents list', three credits may be awarded

Indicative Credits: 3

Comments

Man 02 Responsible Construction Practices

No. of BREEAM credits available	2	Available contribution to overall score:	2.18%
No. of BREEAM innovation credits	1	Minimum Standards	No

Assessment Criteria

Where a compliant considerate construction scheme will be used, credits are awarded depending the score achieved as outlined below:

Indicative Credits: 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 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
Checklist A-3	50% of the optional items	80% of the optional items

Exemplary Credit

Considerate Constructors Scheme	Score of 40 or more with a score of 7 in each section
Alternative Compliant Scheme	Exemplary Level Compliance
Checklist A-3*	All Items (Optional & Mandatory)

* Small Scale Project Only

Indicative Innovation Credits Achieved
0

Comments

Man 03 Construction Site Impacts

No. of BREEAM credits available	1	**Available contribution to overall score**	1.09%
No. of BREEAM innovation credits	0	**Minimum Standards applicable**	No

Assessment Criteria

Where evidence demonstrate that site impacts will be monitored, as detailed below:

Indicative Credits
1

	One Credit
Large Scale	Where there is evidence to demonstrate that **2 or more** of the sections in **Checklist A-4** are completed
Small Scale	Where there is evidence to demonstrate that **2 or more** of the sections in **Checklist A-5** are completed

Sections of Checklist

Large Scale - Checklist A-4	Small Scale - Checklist A-5
Monitor, report and set targets for CO_2 production of energy use arising from site activities	Set objectives for reducing CO_2 production from energy use arising from site activities
Monitor, report and set targets for water consumption arising from site activities	

Monitor, 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	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

Comments

Man 04 Security

No. of BREEAM credits available	**2**	**Available contribution to overall score:**	**2.18%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable:**	**No**

Assessment Criteria
Where the following requirements will be met:

Indicative Credits: 0

One Credit Secure windows and doors	External doors and accessible windows meet minimum standards and appropriately certified
Two Credits Secured by design	Principles and guidance of Secured by Design Section 2 are complied with
	A suitably qualified security consultant is consulted at the design stage and their recommendations are incorporated into the refurbishment

Comments

Man 05 Protection and Enhancement of Ecological Features

No. of BREEAM credits available	**1**	**Available contribution to overall score:**	**1.09%**
No. of BREEAM innovation credits	**1**	**Minimum Standards applicable:**	**No**

Assessment Criteria
Where the following requirements will be met:

Indicative Credits: 0

One Credit Protecting 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
Exemplary Credit **Ecological enhancement**	A suitably qualified ecologist recommends features to enhance ecology of the site
	adopts all general ecological recommendations
	adopts 30% of additional recommendations

Indicative Innovation Credits Achieved: 0

Comments

Man 06 Project Management

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.18%**
No. of BREEAM innovation credits	**2**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where the following requirements will be met:

Indicative Credits: 0

One Credit Project Roles and Responsibilities	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 **Large Scale** - the project manager assigns individual and shared responsibilities across the following key design and refurbishment stages: i. Planning and Building control notification ii. Design iii. Refurbishment iv. Commissioning and handover v. Occupation

Small Scale projects: five units or fewer and less than £100k

Large Scale projects: more than five units and more than £100k

One Credit Handover and Aftercare	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

Indicative Innovation Credits Achieved: 0

Exemplary Credits

One Exemplary Credit Early Design Input	Where A BREEAM Accredited Professional has been appointed to oversee key stages within the project. OR Where a BREEAM Domestic Refurbishment Assessor has been appointed at an early

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

Comments

HEALTH & WELLBEING	Section Weighting: 17%	Indicative Section Score 14.17%

Hea 01 Daylighting

No. of BREEAM credits available	2	Available contribution to overall score	2.83%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Indicative Credits: 2

Where the refurbishment results in a neutral impact on daylighting or where minimum daylighting standards are met, up to two credits may be awarded as follows:

For Existing Dwellings and Change of Use Projects

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

First Credit Maintaining Good Daylighting	New spaces achieve minimum daylighting levels
	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

Comments

Hea 02 Sound Insulation

No. of BREEAM credits available	4	Available contribution to overall score	5.67%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Indicative Credits: 4

To ensure the provision of acceptable sound insulation standards and so minimise the likelihood of noise complaints.

Properties where sound testing has been carried out:

Up to Four Credits	Four credits awarded according to the improvement over building regulations. See table in additional information in Technical Manual

Properties where sound testing is not feasible and not required by the appointed Building Control body

Two Credits	Where existing separating walls and floors are designed to meet the requirements of Building Regulations with compliant construction details

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

Up to Four Credits	Where the dwelling is a Historic Building and sound testing results demonstrate existing separating walls and floor meet the Historic Building credit requirements
	See table in additional information in Technical Manual
	Where sound testing is not feasible and not required by the appointed Building Control body meeting criteria 2 and 3 using Table 12
	Properties where sound testing has been carried out, credits awarded according to the improvement over building regulations. See table in additional information in Technical 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 between non habitable rooms OR Testing not required by building control body

Four Credits	By Default

Comments

Hea 03 Volatile Organic Compounds

No. of BREEAM credits available	**1**	**Available contribution to overall score**	**1.42%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where the refurbishment avoids the use of VOCs with new products meeting the following requirements:

Indicative Credits: 1

One Credit Avoiding the use of VOCs	Where all decorative paints and varnishes used in the refurbishment have met the requirement listed in table 5.4 in the Technical Manual
	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.

Comments

Hea 04 Inclusive Design

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.83%**
No. of BREEAM innovation credits	**1**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where an access statement has been carried out using Checklist A-8 of the Technical Manual to optimise the accessibility of the home as follows:

Indicative Credits: 0

	Checklist A-8 of the Technical Manual	
	Section 1	**Section 2**
One Credit Minimum Accessibility	Completed with Evidence	
Two Credits Advanced Accessibility	Completed with Evidence	Completed with Evidence

Exemplary Performance

One Credit	Where an access expert suitably qualified member of the design team has completed sections 1, 2 and 3 of Checklist A-8, access statement template with evidence provided of the measures implemented in the refurbishment

Indicative Innovation Credits Achieved: 0

Comments

Hea 05 Ventilation

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.83%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**Yes**

Assessment Criteria

Where the dwelling meets the following ventilation requirements:

Indicative Credits: 2

One Credit Minimum Ventilation Requirements	A minimum level of background ventilation is provided (with trickle ventilators or other means of ventilation) for all habitable rooms, kitchens, utility rooms and bathrooms compliant with section 7, Building Regulations Approved Document Part F, 2010
	A minimum level of extract ventilation is provided in all wet rooms (e.g. kitchen, utility and bath-rooms), compliant with section 5, Building Regulations Approved Document Part F 2010.
	A minimum level of purge ventilation is provided in all habitable rooms and wet rooms, compliant with section 7, Building Regulations Approved Document Part F, 2010.

	It is an historic building and meets historic building requirements in CN4 of the technical manual
Two Credits Advanced Requirements	Ventilation is provided for the dwelling that meets the requirements of Section 5 of Building Regulations Part F in full
	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**

Assessment Criteria

Indicative Credits: 1

Where a fire and carbon monoxide (CO) detection and alarm system is specified as follows:

One Credit Fire and Carbon Monoxide (CO) Detection and Alarm Systems	Where a compliant fire detection and fire alarm system is provided
	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-wiring**

Comments

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 Credits: 4

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

Comments	

Ene 02 Energy Efficiency Rating Post Refurbishment

No. of BREEAM credits available	4	**Available contribution to overall score**	5.93%
No. of BREEAM innovation credits	2	**Minimum Standards applicable**	Yes

Assessment Criteria

Where the following Energy Efficiency Rating benchmarks will be met as a result of refurbishment:

Indicative Credits: 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	

Exemplary	Credits
≥90	1
≥100	2

Indicative Innovation Credits Achieved: 1

Comments

Ene 03 Primary energy demand

No. of BREEAM credits available	7	**Available contribution to overall score**	10.38%
No. of BREEAM innovation credits	0	**Minimum Standards applicable**	No

Assessment Criteria

Where the following Primary Energy Demand benchmarks will be met as a result of refurbishment:

Indicative Credits: 6.5

Primary Energy Demand Post Refurbishment	Credits
≤ 400	0.5
≤ 370	1
≤ 340	1.5
≤ 320	2
≤ 300	2.5
≤ 280	3
≤ 260	3.5
≤ 240	4
≤ 220	4.5
≤ 200	5

≤ 180	5.5
≤ 160	6
≤ 140	6.5
≤ 120	7

Comments

Ene 04 Renewable Technologies

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.97%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where the dwelling will meet the following % contribution from renewables and primary energy demand targets as a result of refurbishment

Indicative Credits: 2

Dwelling Type	Primary Energy Demand	Percentage from Renewables	
		1 Credit	2 Credits
Detached	≤ 250 kWh/m²/year	≥10%	≥20%
Semi-Detached		≥10%	≥20%
Bungalow		≥10%	≥20%
End of Terrace		≥10%	≥20%
Mid Terrace	≤ 220 kWh/m²/year	≥10%	≥20%
Low Rise Flat		≥10%	≥20%
Mid Rise Flat		≥10%	≥15%
High Rise Flat		≥10%	≥15%

Comments

Ene 05 Energy Labelled White Goods

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.97%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where Energy Efficiency White goods are to be provided as follows:

Indicative Credits: 1

First Credit

Appliance	Appliance provided	Appliance not to be provided
Fridges, Freezers and Fridge-Freezers	A+ Rating under EU Energy Efficiency Labelling Scheme	EU Energy Efficiency Labelling Scheme Information Leaflet provided to all dwellings

Second Credit

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 contribution to overall score**	**1.48%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where adequate, secure internal or external space with posts and footings or fixings is provided with the following:

Indicative Credits
0

1 Credit	
Number of bedrooms	**Drying line required**
1-2	4m+
3+	6m+

Comments

Ene 07 Lighting

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.97%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where energy efficient internal and external lighting is provided as follows:

Indicative Credits
2

External Lighting - 1
Energy Efficient Space Lighting of more than 45 lumens per circuit watt and Energy Efficient Security Lighting OR
Where Energy Efficient Space Lighting is provided ONLY

Internal Lighting - 1
Maximum average wattage across the total floor area of the dwelling of 9 watts/m2

Comments

Ene 08 Display Energy Devices

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.97%**
No. of BREEAM innovation credits	**1**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where consumption data is displayed to occupants by a compliant energy display device

Indicative Credits
2

Electricity usage data displayed	Primary Heating Fuel	
	Electricity	Other
Electricity usage data displayed	2 credits awarded	1 credit awarded
Primary Heating Fuel usage data displayed	N/A	1 credit awarded
Electricity & Primary Heating Fuel usage displayed	N/A	2 credits awarded

Exemplary Credits

One credit Recording consumption data	Where the first two credits are achieved	
	Where any compliant Energy Display Device is capable of recording consumption data	

Indicative Innovation Credits Achieved: 1

Comments

Ene 09 Cycle Storage

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**2.97%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where individual or communal compliant cycle storage is provided as follows:

Indicative Credits: 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 to overall score**	**1.48%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where sufficient space and services will be provided to allow occupants to set up a home office in a suitable room with adequate ventilation

Indicative Credits: 0

Comments

WATER	Section Weighting: 11%	Indicative Section Score 8.80%

Wat 01 Internal Water Use

No. of BREEAM credits available	**3**	**Available contribution to overall score**	**6.60%**
No. of BREEAM innovation credits	**1**	**Minimum Standards applicable**	**Yes**

Assessment Criteria

Indicative Credits
2

Where the dwellings water consumption meets the following consumption benchmarks, or where terminal fittings meet the following water consumption standards:

Calculated Water Consumption (litres/person/day)	Equivalent terminal fitting standards	Minimum Standard	Credits
>150	Typical baseline 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	All showers specified to 'Excellent' **OR** All showers and bathroom taps to 'Good'	BREEAM Very Good	1
from 118 to < 129	All bathroom and WC room fittings specified to 'Good' **OR** All bathroom fittings specified to 'Excellent'	N/A	1.5
from 107 to < 118	All Bathroom and WC room fittings specified to 'Excellent' **OR** All Bathroom fittings Specified to 'Excellent' and WC room fitting specified to 'Good' **OR** All Bathroom fittings, kitchen and utility sittings specified to 'Good'	BREEAM Excellent	2
from 96 to < 107	All kitchen, bathroom, utility room and WC room fittings specified to 'Good' **OR** All bathrooms, kitchens and utility rooms specified to 'Excellent'	N/A	2.5
< 96	All bathroom fittings specified to 'Excellent' and WC room, kitchen and utility room fittings specified to 'Good'	BREEAM Outstanding	3

NOTE: 'Good' fittings are equivalent to good practice fittings with "Excellent" fittings equivalent to best practice fittings (see the technical manual for full details.

Exemplary Credit	If the water consumption is less than 80l/person/day

Indicative Innovation Credits Achieved
0

Comments

Wat 02 External Water Use

No. of BREEAM credits available	**1**	**Available contribution to overall score**	**2.20%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where the following requirements will be met:

Indicative Credits
1

Requirements:

One Credit	Where a compliant rainwater collection system for external/internal irrigation use has been provided to dwellings. **OR** Where dwellings have no individual or communal garden space.

Comments

Wat 03 Water Meter

No. of BREEAM credits available	**1**	**Available contribution to overall score**	**2.20%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where an appropriate water meter for measuring usage of mains potable water meter has been provided to dwelling(s), one credit may be awarded

Indicative Credits
1

Comments

MATERIALS

Section Weighting: 8%

Indicative Section Score 4.00%

Mat 01 Environmental Impact of Materials

No. of BREEAM credits available	**25**	**Available contribution to overall score**	**4.16%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Indicative Credits

16

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

The full 25 credits represents all of the elements containing refurbished or existing materials that meet the Green Guide Rating of A+(6)

GG Rating	Points for existing / refurbished elements	Points for new elements
A+ (6)	5	[redacted]
A+ (5)	4.6	
A+ (4)	4.2	
A+ (3)	3.8	
A+ (2)	3.4	
A+	3	3
A	2	2
B	1	1
C	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

Comments

Mat 02 Responsible Sourcing of Materials

No. of BREEAM credits available	**15**	**Available contribution to overall score**	**2.50%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**Yes**

Assessment Criteria

Where new materials are responsibly sourced, up to 12 credits may be awarded where 80% of new materials for an element are responsibly sourced. The credits achieved are dependent on % of point achieved which is based upon the responsible sourcing tier level of each material sourced as detailed below:

Indicative Credits: 0

Sustainable Procument Plan (3 BREEAM credits)
The principal contractor sources materials for the project in accordance with a documented sustainable procurement plan
OR Where the principal contractor is a Small Company (up to 3 BREEAM credits)
Checklist A-9 is filled in with supporting evidence

Will all new timber used in the project be sourced in accordance with the UK Government's Timber Procurement: **Yes**

Table 1

BREEAM credits	% of available points achieved
12	≥54%
10	≥45%
8	≥36%
6	≥ 27%
4	≥ 18%
2	≥ 9%

Comments

Mat 03 Insulation

No. of BREEAM credits available	**8**	**Available contribution to overall score**	**1.33%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where any new insulation specified for use within external walls, ground floor, roof and buildings services meet the following requirements:

Indicative Credits: 8

Requirements

4 Credits	Where the Insulation Index for new insulation used in the buildings is ≥2
	Where Green Guide ratings are determined using the Green Guide to specification tool

Requirements

4 Credits	Where ≥ 80% of the new thermal insulation used in the building elements is

4 credits	responsibly sourced.	
Comments		

WASTE	Section Weighting: 3%	Indicative Section Score 1.80%

Was 01 Household Waste

No. of BREEAM credits available	**2**	**Available contribution to overall score**	**1.20%**
No. of BREEAM innovation credits	**0**	**Minimum Standards applicable**	**No**

Assessment Criteria

Where compliant recycling and composting facilities are provided, up to two credits may be awarded as follows

Indicative Credits
0

First Credit - Recycling Facilities	
Scenario	**Internal recycling storage requirements**
Compliant collection scheme in place	3 internal recycling containers provided where recycling is not sorted post collection
	1 internal recycling container provided where recycling is sorted post collection
	Minimum 30 litre total capacity, no single container less than 7 litre capacity
	Dedicated position in accordance with compliance note 1
No compliant collection scheme in place No adequate external storage	3 internal recycling containers provided
	Minimum 60 litre total capacity
	Dedicated position in accordance with compliance note 1
No compliant collection scheme in place Adequate external storage provided	3 internal recycling containers provided
	Minimum 30 litre total capacity, no single container smaller than 7 litre
	Dedicated position in accordance with compliance note 1

Second credit - Composting facilities	
With external space	**Without external space**
Where a composting service or facility is provided for green/garden waste	Where a composting service or facility is 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	

	composting waste of at least 7 litres	
Comments		

Was 02 Refurbishment Site Waste Management

No. of BREEAM credits available	**3**	**Available contribution to overall score**	**1.80%**
No. of BREEAM innovation credits	**1**	**Minimum Standards applicable**	**No**

Assessment Criteria

Up to three credits are available depending on the site waste management plan to be implemented as follows

Indicative Credits
3

Indicative Innovation Credits Achieved
0

Projects up to £100k

Three Credits	Where waste generated through the refurbishment process is managed in accordance with Checklist A-9
Exemplary Credit	Where a compliant Level 1; Site Waste Management Plan (SWMP) is in place

Projects up to £300k

Three Credits	Where a compliant Level 1; Site Waste Management Plan (SWMP) is in place
Exemplary Credit	Where a compliant Level 2; Site Waste Management Plan (SWMP) is in place
	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 Management Plan	Where a compliant Level 2; Site Waste Management Plan (SWMP) is in 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
Third Credit Best Practice Waste Benchmarks	Where the first two credits have been achieved achieved
	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 *exemplary level resource efficiency benchmark*
	Where Non-hazardous demolition waste generated by the dwellings refurbishment meets or exceeds the exemplary level diversion benchmarks

Comments

POLLUTION	Section Weighting: 6%	Indicative Section Score 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	Minimum Standards applicable	No

Assessment Criteria

Credits are awarded on the basis of NOx emissions arising from the operation of space heating and hot water systems for each refurbished dwelling as follows:

Indicative Credits
2

	Dry NOx Emissions
One Credit	≤100 mg/kWh (NOx class 4 boiler)
Two Credits	≤70 mg/kWh (NOx class 5 boiler)
Three 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

Where impacts of the refurbishment on surface water runoff are neutralised or where runoff is reduced as a result of refurbishment, up to three credits can be awarded as follows:

Indicative Credits
1

	Requirements
One Credit Neutral Impact on Surface Water	New hard standing areas must be permeable
	If building on to previously permeable area additional run-off must be managed on site
	Calculations should be carried out by an appropriately qualified professional

	Requirements
OR Second Credits Reducing Run-Off From Site: Basic	Where the criteria needed for One Credit has been achieved
	Where all run-off from the roof for rainfall depths up to 5 mm, have been managed on site using source control methods
	Include runoff from all existing and new parts of the roof.
	An appropriately qualified professional should be used to design an appropriate drainage strategy for the site

	Requirements
	Where run-off as a result of the refurbishment is managed on site using source control

OR Three Credits Reducing Run-Off From Site: Advanced	An appropriately qualified professional should be used to design an appropriate drainage strategy for the site.
	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.
	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

Exemplary Credit	Where all run-off from the developed site is managed on site using source control
	The peak rate of run-off as a result of the refurbishment for the 1 in 1 year event is reduced to zero.
	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).

Indicative Innovation Credits Achieved

Please Select

Comments

Pol 03 Flooding

No. of BREEAM credits available	2	**Available contribution to overall score**	1.50%
No. of BREEAM innovation credits	0	**Minimum Standards applicable**	Yes

Assessment Criteria

Where the dwelling is located in a low flood risk zone, or where in a medium to high flood risk zone and a flood resilience/resistance strategy has been implemented, up to two credits can be awarded as follows:

Indicative Credits

2

Minimum Standards	A minimum of two credits must be achieved for this issue at the Excellent and

Minimum Standards	Outstanding levels

Option 1 - Low Flood Risk

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.

Option 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

Comments