Energy Report

White Post Road

Client: Barratt Mercia

Author: William Vincent

www.environmental-economics.co.uk

Revision History

Version	Date Issued	Reason for Issue	Issued by	QA Check
1	17/07/2019	Report provided in support of planning application	[redacted] *William Vincent*	[redacted] *Michael Woodbridge*

Contents

1. Project Overview

1.1. Introduction

This energy and carbon compliance study was prepared by Environmental Economics Ltd on behalf of Barratt Mercia. The report assesses measures to reduce the energy demand and carbon emissions for the domestic housing on site through an improvement in materials and products used.

1.2. Description of Site

The site consists of 280 plots. These units comprise a range of detached, semi-detached and terraced dwellings.

The proposed site location/boundary for the whole site is shown in Appendix A.

This report addresses a domestic development being undertaken by Barratt Mercia, and does not include any further proposals for subsequent developments or non-residential parcels.

1.3. Client Brief

The planning authority for this site is Cherwell District Council. In order to achieve compliance with Part L 2013 Building Regulations the design carbon emissions (DER) do not surpass the target carbon emissions (TER), and that the fabric energy efficiency of the design (DFEE) is either equivalent or better than the target fabric energy efficiency (TFEE).

2. Improvement Measures

2.1. Assessment Methodology

Environmental Economics have modelled the proposed dwellings using NHER Plan Assessor software. The software provides a number of outputs which can be used to assess and compare the improvements from any number of build specifications in terms of:

- *Building regulations compliance*
- *Energy usage per year (kWh/annum)*
- *Carbon emissions as a measure of building regulations compliance (kg CO2/m2/year)*
- *Energy costs per year (£/annum)*
- *More detailed breakdowns by end use (space heating, water heating, cooking, lighting, appliances)*
- *Code for Sustainable Homes compliance*
- *Effective air change rate*

Each of these outputs can be used in different ways to analyse the performance of the dwelling. The total regulated carbon emissions for each property is based upon:

- *Space heating*
- *Water heating*
- *Electricity for pumps and fans*
- *Electricity for lighting*

Two models were created in order to calculate the different carbon emissions from the specification improvements. The total emission of carbon for the site is calculated for each of the models, and then the difference used to establish the level of improvement. In order to achieve this representative house types have been utilised.

The emissions calculation for the space and water heating, as well as the electricity for pumps, fans and lighting were all assessed using the Standard Assessment Procedure (SAP 2012) through version 6 of the NHER Plan Assessor software. An example SAP worksheet is shown in Appendix C.

2.2. Design Philosophy

Barratt Mercia has upgraded a number of elements from a standard build specification in order to improve energy efficiency across the development. The site adopts the good design principles endorsed and promoted by The Zero Carbon Hub, the construction industries' key advisors and partners with the Governments Communities and Local Government Department. This guidance follows the general good principles of energy efficiency as the industry moves towards zero carbon. The principles are illustrated in figure 1 below.

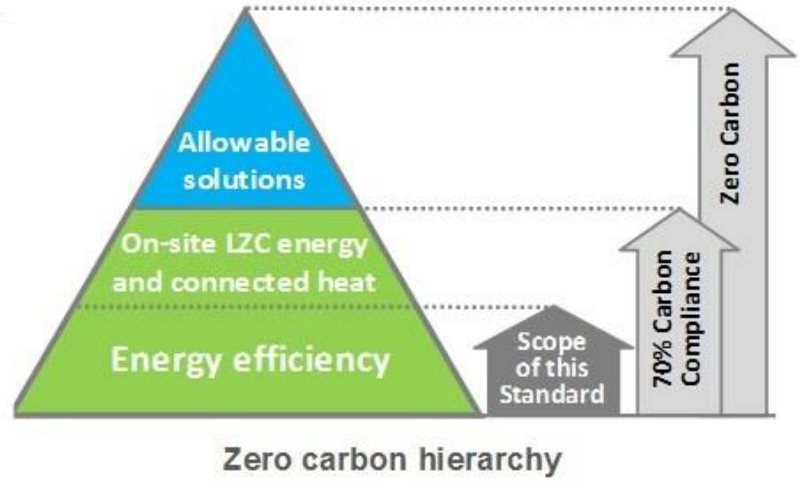


Figure 1

In order to reduce the residual carbon emissions a number of improvements were made to the standard material and product specification. These improvements include:

- *Upgraded heating and hot water controls*
- *Delayed start thermostat*
- *Design air permeability of 5.01m3/hr/m2*
- *Bespoke thermal bridging details*

2.3. Specification Improvements

In order to improve energy efficiency the products and the fabric of the dwellings was improved from basic compliance with Part L1A 2013 to an enhanced specification.

2.3.1. Product Improvements

The systems used in a property to supply hot water and heating, as well as control it, are important to the overall energy demand of a property. The 2013 Building Regulations state that all systems and their controls must adhere to the minimum standards shown in Domestic Heating Compliance Guide.

For a mains gas fired system the minimum boiler efficiency required is 86%. Barratt Mercia intends to use Ideal Logic condensing boilers throughout the site for both combination and cylinder based systems. These boilers achieve a SAP 2012 rated efficiency of at least 89% and are recommended by the Energy Saving Trust.

Where installed, hot water cylinders can lose a significant amount of energy. In order to minimise this energy loss and corresponding carbon emissions Barratt Mercia will utilise Kingspan Tribune Cylinders which have higher levels of insulation in comparison to typical hot water cylinders.

Finally 100% Low-E lighting fixtures shall be fitted to all properties.

2.3.2. *Fabric Improvements*

The building fabric for all dwellings was improved from basic compliance with Part L1A 2013 to an enhanced specification. These fabric improvements reduce the space heating requirement upon a property. The improvements have been made through a combination of upgraded materials and increased insulation thicknesses. Enhanced glazing with a larger transmittance factor allowing for increased solar gains will also be used. Changes to the U-Value of external elements are shown in table 1 below.

Element	Minimum Standard	Improved Specification	
-	W/m^2k	Description	W/m^2k
Walls	0.30	50mm Alreflex Platinum Cavity	0.27
Roof	0.20	400mm Mineral Wool Horizontal Ceiling, Loft Space	0.11
		Flat Roof	0.17
Floors	0.25	150mm TE Platinum Beam & Block Floor	0.14 - 0.15
Doors	2.00	Double glazed Low-E, u-PVC frame	1.00 – 1.70
Glazing	2.00	Double glazed Low-E, u-PVC frame	1.41

Table 1

As improvements are made to the thermal conductivity of main elements, thermal bridging and air permeability becomes increasingly significant in the overall fabric performance. Barratt Merciautilise bespoke thermal bridging designs assessed by H&H Celcon, which achieve much lower heat loss levels in comparison with standard practice.

As a result of following these junction details and focusing on build quality air permeability will also decrease. A target air pressure rating of 5.01$m^3/hr.m^2$ has been set for all houses on site which is a 50% improvement on the maximum allowable rating in the 2013 Building Regulations.

2.3.3. *Hi-Therm Lintels*

As the latest set of building regulations have incorporated a Target Fabric Energy Efficiency (TFEE) standard for all new houses, some of the bespoke thermal bridging details would not be sufficient to achieve the latter.

Since a significant amount of heating energy is lost through the dwellings lintels, Barratt Merciaintend to use IG Hi-Therm lintels on this site. IG Hi-Therm lintels achieve a lower linear thermal transmittance (Psi value) of 0.05W/mK, in comparison to the normal IG lintels which achieve a Psi value of 0.23W/mK. More details are shown in Appendix D.

2.3.4. *Waste Water Heat Recovery Systems (WWHRS)*

WWHRS recovers heat from the warm waste water as it passes through a double walled heat exchanger, before going in the drainage system. The heat is transferred to the mains cold water supply, which is then supplied to the mains cold feed to the shower and/or a combination boiler or a hot water storage cylinder.

This process makes a significant reduction to the energy demand for providing hot water. The energy recovered depends on the temperature of the cold water feed to the dwelling, which varies by month, and the number of systems that are installed. The WWHRS is installed vertically below the point of demand, i.e. within the waste ducting below the shower or bath. A simple schematic of a WWHRS is shown in figure 2.

The housetypes with WWHRS are H417--7 and H456--7.

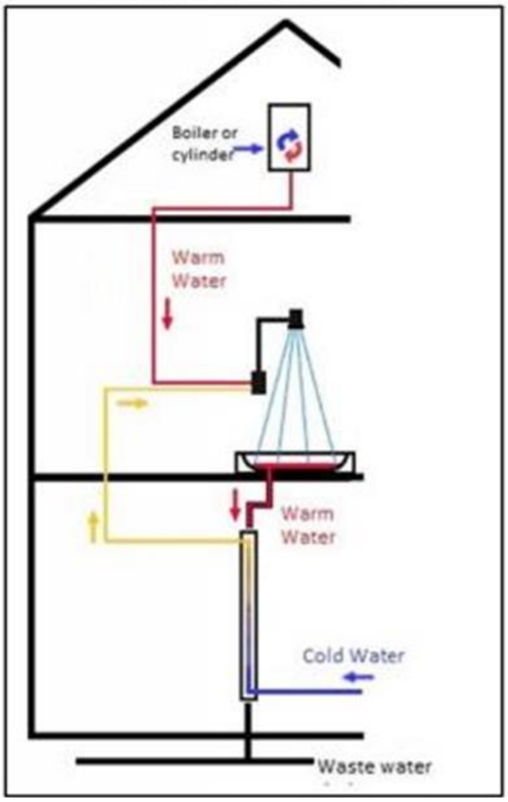


Figure 2

2.4. Low and Zero Carbon Technologies

2.4.1. Photovoltaic (PV) Cells

The efficiency of PV cells has improved rapidly over the last 15 years. This has made a previously uneconomical technology an increasingly viable solution to rising energy costs and demand. The cells can be produced in a variety of formats but are typically manufactured as a panel or a roof tile for domestic housing applications.

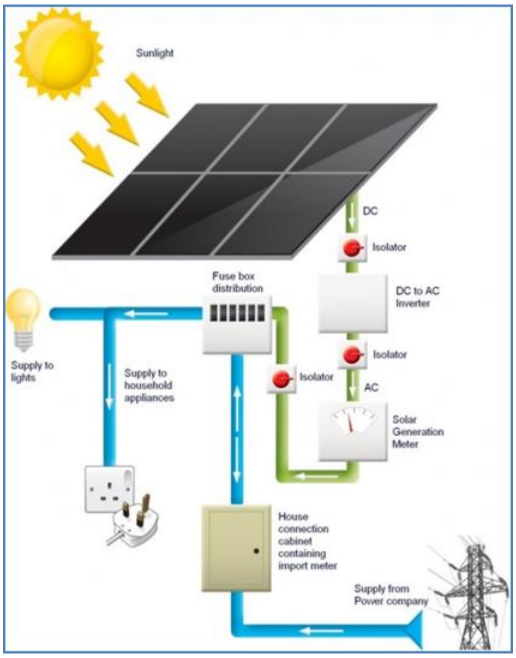


Figure 3

The PV system typically produces direct current (DC) which is then sent through an inverter to supply the house with electricity. If a greater amount of electricity is produced than used by the household, this extra can be sold back to the national grid, as can be seen in figure 3.

A PV cell is assessed on its peak power rating. This is tested by exposing the cell to the equivalent of full solar radiation and measuring the power output. The peak power is input into the NHER software as well as the physical attributes of the installation such as pitch, orientation and over-shading. A total energy saving per year can then be calculated through SAP for the PV installation. This is then offset against the electricity energy demand for the house.

2.4.2. Solar Hot Water (SHW)

SHW systems provide hot water to a household usually in conjunction with a conventional boiler and cylinder system. Because of this they are best suited to houses with a need for a cylinder hot water system rather than a combi boiler.

Figure 4

There are two main SHW systems; evacuated tubes and flat plate collectors. Evacuated tubes are more efficient at transferring solar irradiation to the fluid although flat plate collectors are considered to be better aesthetically and to install. An example of the latter can be seen in figure 4.

The final energy contribution to the household, calculated through SAP, is based on a number of factors:

- *Pitch, orientation and over-shading*
- *Heat absorption efficiency for the collector*
- *Average hot water usage of the dwelling*

The majority of the energy savings will be made in the hot water demand for the dwelling however, adding a SHW system will impact upon other energy demands.

2.4.3. Air Source Heat Pumps (ASHP)

ASHP provide heating and hot water to a home through thermal energy gathered from air outside the dwelling. Systems can be designed to work in conjunction with a boiler system but in the case of energy efficient new builds it is possible for an ASHP unit to provide 100% of the heating and hot water demand.

Figure 5

The thermal performance of the unit depends on the outside temperature as well as the unit's Coefficient of Performance. This is the ratio of thermal energy produced to energy used. A typical value for this would be around 3.5, meaning that for every 1kW of electricity consumed the unit would provide 3.5kW of thermal energy to the household. This efficiency leads to large carbon and energy savings for both space and water heating.

ASHP are assessed by their power output and the size of unit chosen depends on the demand from the household. An example external unit can be seen above in figure 5. The units with a larger power output can provide a larger amount of hotter water even in colder climates

2.4.4. Ground Source Heat Pumps (GSHP)

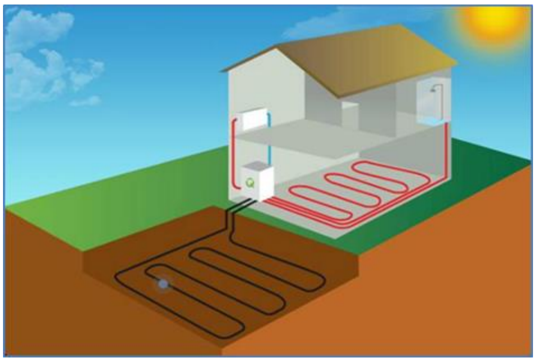


Figure 6

GSHP provide heating and hot water to a dwelling through geothermal effects. A GSHP system would offset the energy demand from the main space heating. There is, however, an additional electricity demand for the pump and control system. This would reduce energy savings from the installation.

GSHP are expensive to install and rely on having appropriate ground conditions and suitable space around the dwelling for the pipe looping. Energy savings are dependent upon the type of system being replaced and the way the system is operated by the homeowner. A typical system can be seen above in figure 6.

2.4.5. *Biomass Heating Systems*

Biomass heating systems burn fuels, considered carbon neutral, to heat the water required for a dwelling. There are a large variety of systems available and choice depends on the type of fuel to be burned and the level of automation.

Figure 7

The system would offset the energy demand from the hot water and main space heating. However, biomass systems typically require a large amount of maintenance and monitoring. An example system can be seen in figure 7.

The savings from such a system, in terms of CO2 and money, depends upon what it is replacing. The savings are greatest when replacing an electrical hot water system but are considerably less for replacing mains gas.

2.4.6. *Wind Turbines*

Figure 8

Wind turbines provide electricity directly to a dwelling. They can be added to a property in two ways: pole mounted or building mounted. The pole mounted systems are free standing and therefore require enough space around them to allow for the construction and maintenance of the structure, as well as to allow for efficient operation. The building mounted systems have a lower power output but do not require additional structures, as can be seen in figure 8.

The energy produced from a wind turbine is heavily dependent upon the surrounding landscape. The energy saved will be offset against the electricity usage of the dwelling.

2.4.7. Comparison

SHW can be easily incorporated into new build house designs and has the potential to reduce the energy demand from hot water considerably. The site layout has taken into account passive solar gains and therefore is suitable to benefit fully from solar technology.

The product and installation cost make ASHP an expensive option. There is also a degree of uncertainty about the energy saving that can be obtained from the system as it requires diligent operation. The same can be said of GSHP, as well as the fact that additional extensive ground work is required in order to make use of the system.

Biomass hot water systems are more suited to the replacement of inefficient, carbon heavy systems such as electrical immersion heaters. The requirement of maintenance and monitoring makes it unsuitable for large scale new build developments

The density of the site is a major restriction on the potential energy that could be generated from wind turbines. Surrounding houses and the inner city location would restrict wind speeds. In order to obtain the energy savings required, larger, more expensive pole mounted systems would be required.

The solution of PV panel systems isn't required to meet the reduction, as the fabric performance is sufficient to meet the required targets.

3. Evaluation

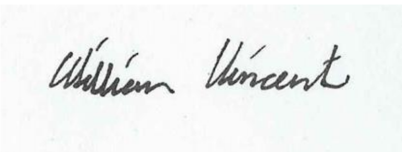
3.1. Conclusion

The tables presented in Appendix B shows the results of the reduction in carbon and energy reduction across the site.

The total carbon emissions target of the Part L 2013 compliance model is 496,721kgCO2/Annum. The total carbon emission for the actual model with the improved specification that would achieve Part L 2013 compliance is 474,782kgCO2/Annum. This results in a 21,939kgCO2/Annum reduction in energy demand, which achieves a 4.42% saving across the site.

The TFEE of the Part L 2013 compliance model is 1,566.2MWh/Annum. The DFEE for the actual model with the improved specification that would achieve Part L 2013 compliance is 1,387.7MWh/Annum. This results in a 178.5MWh/Annum reduction in energy demand, which achieves an 11.4% saving across the site.

Approved for Release



Date: 17/07/2019

Appendix A


DAVID WILSON HOMES
Bodicote
White Post Road
Planning Layout (01)
Sheet 1 of 2
04.04.19
BOD.PL.001S1

Appendix B

Carbon Reduction Study
White Post Road

Client: **Barratt Mercia**
Project: **White Post Road**
Report: **Carbon Emissions Reduction from Fabric and General Specification Improvements**

House Type/ Plot Number	Standard Regulatory Model CO_2 Emissions Rate	Improved Model CO_2 Emissions Rate	Improvement over Regulatory Model	SAP Floor Area	Number of Plots	Annual Carbon Emissions from Improved Model
-	$kgCO_2/m^2.yr$	$kgCO_2/m^2.yr$	%	m^2	-	$kgCO_2/yr$
Alderney Detached	17.01	15.75	7.4%	114	16	28,693
Chester Detached	18.17	17.63	3.0%	94	13	21,640
Ennerdale Detached	18.57	17.60	5.2%	85	9	13,477
H403-C7 Detached	17.61	16.60	5.7%	101	9	15,032
H417---7 Detached	16.33	15.23	6.7%	135	10	20,488
H418---7 Detached	17.12	16.63	2.9%	137	9	20,541
H421---7 Detached	15.40	15.27	0.8%	164	2	5,023
H455---7 Detached	16.26	16.16	0.6%	127	9	18,482
H456---7 Detached	16.16	15.63	3.3%	140	15	32,866
H469-X7 Detached	15.82	15.69	0.8%	143	14	31,412
H577---7 Detached	14.97	14.64	2.2%	181	10	26,554
H588---7 Detached	15.08	14.81	1.8%	184	8	21,752
Lutterworth Det BB	18.50	17.73	4.2%	92	1	1,623
Maidstone Semi-Detached	18.44	17.18	6.8%	77	29	38,360
P341-E-7 Semi-Detached	17.92	16.72	6.7%	93	4	6,224
P382-E-7 Semi-Detached	18.70	17.53	6.3%	77	21	28,456
Radleigh Detached	16.63	16.50	0.8%	121	17	33,867
SH50 Semi-Detached	19.95	18.98	4.9%	70	8	10,584
SH52 Semi-Detached	18.23	17.01	6.7%	86	19	27,790
SH55 Semi-Detached	17.56	16.54	5.8%	89	1	1,472
Type 50 Semi-Detached	19.60	18.54	5.4%	70	12	15,509
Type 52 Semi-Detached	17.91	16.62	7.2%	86	28	40,039
Type 75 Semi-Detached	22.39	21.52	3.9%	43	16	14,897
			Total Annual Carbon Emissions *($kgCO_2/yr$)*			**474,782**

Floor Area Weighted Average Improvement (%)
4.4%

Notes
#1: Calculated by SAP2012 to include total energy demand for space heating, hot water, lighting, pumps and fans.

Energy Demand Reduction Study
White Post Road

Client: Barratt Mercia
Project: White Post Road
Report: Energy Demand Reduction from Fabric and General Specification Improvements

House Type/ Plot Number	Standard Regulatory Model Fabric Efficiency	Improved Model Fabric Efficiency	Improvement over Regulatory Model	SAP Floor Area	Number of Plots	Annual Energy Demand from Improved Model
-	$kWh/m^2.yr$	$kWh/m^2.yr$	%	m^2	-	kWh/yr
Alderney Detached	54.48	48.51	11.0%	114	16	88,368
Chester Detached	54.23	48.79	10.0%	94	13	59,881
Ennerdale Detached	55.70	50.90	8.6%	85	9	38,964
H403-C7 Detached	53.20	48.10	9.6%	101	9	43,547
H417---7 Detached	57.52	51.04	11.3%	135	10	68,662
H418---7 Detached	61.11	52.12	14.7%	137	9	64,379
H421---7 Detached	56.39	49.83	11.6%	164	2	16,393
H455---7 Detached	55.50	49.44	10.9%	127	9	56,542
H456---7 Detached	56.19	50.13	10.8%	140	15	105,408
H469-X7 Detached	55.47	49.21	11.3%	143	14	98,521
H577---7 Detached	55.88	48.71	12.8%	181	10	88,357
H588---7 Detached	56.58	49.39	12.7%	184	8	72,549
Lutterworth Det BB	56.12	50.69	9.7%	92	1	4,640
Maidstone Semi-Detached	50.77	44.62	12.1%	77	29	99,627
P341-E-7 Semi-Detached	53.01	46.33	12.6%	93	4	17,241
P382-E-7 Semi-Detached	52.90	46.98	11.2%	77	21	76,263
Radleigh Detached	55.34	48.93	11.6%	121	17	100,426
SH50 Semi-Detached	56.71	51.37	9.4%	70	8	28,654
SH52 Semi-Detached	51.98	46.38	10.8%	86	19	75,760
SH55 Semi-Detached	49.74	45.05	9.4%	89	1	4,010
Type 50 Semi-Detached	53.29	47.35	11.1%	70	12	39,606
Type 52 Semi-Detached	49.77	43.98	11.6%	86	28	105,920
Type 75 Semi-Detached	54.74	49.08	10.3%	43	16	33,974
			Total Annual Energy Requirements *(kWh/yr)*			**1,387,693**

Floor Area Weighted Average Improvement (%)
11.4%

Notes
#1: Calculated by SAP2012 to include total energy demand for space heating, hot water, lighting, pumps and fans.

Appendix C

DER Worksheet
Design - Draft

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

Assessor name	5982 Hazel Black	Assessor number	5982
Client		Last modified	04/05/2019
Address	xx xx, xx, xx		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		56.93	(1a)	x	2.33	(2a)	=	132.65	(3a)
+1		56.93	(1b)	x	2.55	(2b)	=	145.17	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	113.86	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			277.82	(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		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.11	(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		5.01	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.36	(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) =	0.30	(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	0.39	0.38	0.37	0.34	0.33	0.29	0.29	0.28	0.30	0.33	0.34	0.36	(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

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

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

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(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			19.85	x	1.33	=	26.49			(27)
Door			1.93	x	1.00	=	1.93			(26)
Ground floor			56.93	x	0.14	=	7.97			(28a)
External wall			138.79	x	0.27	=	37.47			(29a)
Roof			56.93	x	0.11	=	6.26			(30)
Total area of external elements ∑A, m²			274.43							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	80.13	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		120.30	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.81	(36)
Total fabric heat loss	(33) + (36) =	88.94	(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)	52.76	52.49	52.23	50.99	50.76	49.68	49.68	49.48	50.10	50.76	51.23	51.72	(38)
Heat transfer coefficient, W/K (37)m + (38)m	141.70	141.43	141.16	139.93	139.70	138.62	138.62	138.42	139.03	139.70	140.16	140.65	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.24	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24	
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)

Heat transfer coefficient: Average = ∑(39)1...12/12 = 139.93 (39)

Heat loss parameter: Average = ∑(40)1...12/12 = 1.23 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.84	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.56	(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)	111.71	107.65	103.59	99.53	95.46	91.40	91.40	95.46	99.53	103.59	107.65	111.71	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	165.67	144.89	149.52	130.35	125.08	107.93	100.01	114.77	116.14	135.35	147.74	160.44	
Distribution loss 0.15 x (45)m	24.85	21.73	22.43	19.55	18.76	16.19	15.00	17.22	17.42	20.30	22.16	24.07	(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	14.15	12.77	14.12	13.62	14.04	13.55	13.98	14.02	13.59	14.08	13.67	14.14	(61)

Hot water usage: ∑(44)1...12 = 1218.69 (44)

Energy content: ∑(45)1...12 = 1597.90 (45)

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

179.82	157.67	163.63	143.98	139.12	121.48	113.99	128.79	129.73	149.43	161.41	174.58	(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

179.82	157.67	163.63	143.98	139.12	121.48	113.99	128.79	129.73	149.43	161.41	174.58

∑(64)1...12 = 1763.63 (64)

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

58.62	51.37	53.24	46.75	45.10	39.27	36.75	41.67	42.01	48.52	52.54	56.88	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	141.81	141.81	141.81	141.81	141.81	141.81	141.81	141.81	141.81	141.81	141.81	141.81	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.36	22.52	18.31	13.87	10.36	8.75	9.45	12.29	16.50	20.94	24.45	26.06	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.99	279.86	272.62	257.20	237.74	219.44	207.22	204.35	211.59	227.01	246.47	264.77	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.18	37.18	37.18	37.18	37.18	37.18	37.18	37.18	37.18	37.18	37.18	37.18	(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)	-113.44	-113.44	-113.44	-113.44	-113.44	-113.44	-113.44	-113.44	-113.44	-113.44	-113.44	-113.44	(71)
Water heating gains (Table 5)	78.79	76.44	71.56	64.93	60.62	54.55	49.39	56.00	58.35	65.22	72.97	76.45	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	449.68	447.37	431.04	404.54	377.26	351.28	334.61	341.18	354.98	381.72	412.44	435.82	(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	
NorthEast	0.77	x	4.68	x	11.28	x 0.9 x	0.71	x	0.70	=	18.19	(75)
SouthEast	0.77	x	5.27	x	36.79	x 0.9 x	0.71	x	0.70	=	66.78	(77)
SouthWest	0.77	x	6.75	x	36.79	x 0.9 x	0.71	x	0.70	=	85.54	(79)
NorthWest	0.77	x	3.15	x	11.28	x 0.9 x	0.71	x	0.70	=	12.24	(81)

Solar gains in watts ∑(74)m...(82)m	182.75	321.40	466.60	623.14	739.04	751.76	717.26	628.03	520.38	362.46	220.74	155.21	(83)
Total gains - internal and solar (73)m + (83)m	632.43	768.77	897.64	1027.68	1116.30	1103.05	1051.87	969.21	875.36	744.17	633.17	591.03	(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	0.97	0.94	0.89	0.79	0.65	0.52	0.57	0.77	0.92	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.63	18.92	19.36	19.93	20.43	20.77	20.91	20.89	20.61	19.95	19.18	18.57	(87)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.88	19.89	19.89	19.90	19.90	19.91	19.91	19.91	19.90	19.90	19.90	19.89	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.96	0.93	0.86	0.75	0.58	0.41	0.46	0.71	0.90	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	16.72	17.14	17.79	18.60	19.28	19.71	19.85	19.83	19.53	18.64	17.53	16.65	(90)

Living area fraction — Living area ÷ (4) = 0.14 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	16.99	17.39	18.01	18.79	19.44	19.86	20.01	19.98	19.68	18.83	17.77	16.92	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	16.84	17.24	17.86	18.64	19.29	19.71	19.86	19.83	19.53	18.68	17.62	16.77	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.94	0.90	0.83	0.72	0.56	0.41	0.45	0.68	0.87	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	609.17	723.21	810.01	854.26	802.31	619.73	426.88	440.90	596.92	645.51	598.16	572.52	(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]	1777.39	1745.51	1603.92	1362.48	1060.49	708.37	451.35	475.35	755.32	1128.16	1474.23	1768.15	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	869.15	686.99	590.67	365.92	192.08	0.00	0.00	0.00	0.00	359.09	630.77	889.55	

∑(98)1...5, 10...12 = 4584.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 40.26 (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 (%)		90.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	960.39	759.10	652.67	404.33	212.25	0.00	0.00	0.00	0.00	396.78	696.99	982.93

∑(211)1...5, 10...12 = 5065.44 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	89.93	89.88	89.79	89.57	89.13	87.30	87.30	87.30	87.30	89.54	89.83	89.96	(217)
Water heating fuel, kWh/month	199.95	175.41	182.25	160.74	156.09	139.15	130.57	147.52	148.60	166.90	179.69	194.07	

∑(219a)1...12 = 1980.94 (219)

Annual totals

Space heating fuel - main system 1	5065.44
Water heating fuel	1980.94

Electricity for pumps, fans and electric keep-hot (Table 4f)

URN: Alderney Detached version 1
NHER Plan Assessor version 6.2.3
SAP version 9.92

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)				447.78	(232)
Total delivered energy for all uses			(211)...(221) + (231) + (232)...(237b) =	7569.16	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5065.44	x	3.48	x 0.01 =	176.28	(240)
Water heating	1980.94	x	3.48	x 0.01 =	68.94	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	447.78	x	13.19	x 0.01 =	59.06	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	434.17	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.15	(257)
SAP value	83.99	
SAP rating (section 13)	84	(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	5065.44	x	0.216	=	1094.13	(261)
Water heating	1980.94	x	0.216	=	427.88	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1522.02	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	447.78	x	0.519	=	232.40	(268)
Total CO_2, kg/year				(265)...(271) =	1793.34	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.75	(273)
EI value					84.87	
EI rating (section 14)					85	(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	5065.44	x	1.22	=	6179.83	(261)
Water heating	1980.94	x	1.22	=	2416.74	(264)
Space and water heating				(261) + (262) + (263) + (264) =	8596.58	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	447.78	x	3.07	=	1374.70	(268)
Primary energy kWh/year					10201.52	(272)
Dwelling primary energy rate kWh/m2/year					89.60	(273)

Appendix D

IG LINTEL GUIDE

If lintels are required to carry loads not indicated on the load tables, please contact IG's Technical Department.

LINTEL HOTLINE
01633 486486

Fax Back Enquiry Forms are also available for download.
www.iglintels.com/technical

IG Fastrack CAD Database is accessible from iglintels.com

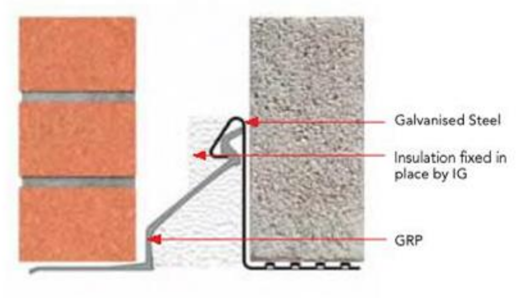
Cavity Wall

Cavity widths from **90mm to 165mm**

OUTER LEAF	INNER LEAF
102mm	100mm

Hi-Therm Lintel

IG leads the way with the development of a completely unique lintel range to address the thermal requirements of new building regulations.



Psi 0.05 W/m·K

Building regulations require that lintels should be assessed for their effect on the thermal performance of a building. The thermal performance of a lintel is expressed in terms of Psi Values (Ψ) i.e. linear thermal transmittance.

Psi COMPARISON CHART

To help understand the immense thermal benefits of the Hi-Therm Lintel it must be compared to other lintel types.

Lintel type comparison	Values
IG Hi-Therm Lintel	0.05 W/m·K
Typical IG Lintel	0.23 W/m·K
Non-plated Steel Lintel (default)	0.3 W/m·K
Plated Steel Lintel (default)	0.5 W/m· K

bre
THERMAL PERFORMANCE TESTING

Testing of IG's Hi-Therm Lintel was carried out by the BRE (Building Research Establishment) using Physibel's thermal analysis software TRISCO which complies with BS EN ISO 10211-1. The modeling follows the requirements of the BRE conventions document BR497.

KEY BENEFITS

- Up to 5 times more thermally efficient than a steel cavity wall lintel, Hi-Therm outperforms other lintels.
- The significant reductions in thermal bridging due to the GRP component will assist in the building design process to achieve compliance with Part L and The Code for Sustainable Homes.
- The use of Hi-Therm will make a significant contribution to a buildings performance in respect of the Fabric Energy Efficiency Standards (FEES).
- Outperforms Stainless Steel on price and corrosion resistance.
- Hi-Therm has achieved the 1 hour fire resistance test as carried out by Exova Warringtonfire utilising the heating conditions of BS EN 1363-1 1999.

DESIGN FEATURES

- Patented GRP and Galvanised Steel hybrid design.
- Galvanised steel is used to support the heavier load on the inner leaf of the cavity wall.
- Profiled CFC free insulation ensures the continuity of insulation.

DAMP PROOFING

Not required on Hi-Therm lintels.
*Check severe exposure.