

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-180				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)			
Property	6, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	88 B	DER	13.57	TER	16.73	
Environmental	88 B	% DER<TER	18.91			
CO ₂ Emissions (t/year)	1.31	DFEE	50.26	TFEE	54.74	
General Requirements Compliance	Pass	% DFEE<TFEE	8.18			
Assessor	Silvio Junges, Tel: 01884 242050				Assessor ID	P637-0001
Client						

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Detached House, total floor area 121 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.73 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.57 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 54.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 50.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.30 (max. 0.70)	OK
Floor	0.18 (max. 0.25)	0.18 (max. 0.70)	OK
Roof	0.17 (max. 0.20)	0.30 (max. 0.35)	OK
Openings	1.37 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 4.73 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Potterton Promax Ultra Combi 40 ErP
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock

Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 2.17 m², No overhang
Windows facing South East: 8.42 m², No overhang
Windows facing South West: 2.11 m², No overhang
Windows facing North West: 7.01 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Door U-value 0.90 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.7300
Infiltration rate					0.3727 (18)
Number of sides sheltered					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3168 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4039	0.3960	0.3880	0.3484	0.3405	0.3009	0.3009	0.2930	0.3168	0.3405	0.3564	0.3722 (22b)
Effective ac	0.5816	0.5784	0.5753	0.5607	0.5580	0.5453	0.5453	0.5429	0.5502	0.5580	0.5635	0.5693 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			16.5600	1.3258	21.9545		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Roof Lights (Uw = 1.60)			1.5200	1.5038	2.2857		(27a)
Jet Floor Lo			43.5000	0.1800	7.8300	75.0000	3262.5000 (28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.2500	36.8900	60.0000	8853.6000 (29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.3000	1.1370	9.0000	34.1100 (29a)
Wall to Void	14.5300		14.5300	0.1600	2.3248	9.0000	130.7700 (29a)
Plane	22.8000		22.8000	0.1300	2.9640	9.0000	205.2000 (30)
Sloping	13.9200	1.5200	12.4000	0.1600	1.9840	9.0000	111.6000 (30)
Bay	0.9700		0.9700	0.1300	0.1261	9.0000	8.7300 (30)
Ceiling to Void	7.3700		7.3700	0.2600	1.9162	9.0000	66.3300 (30)
Dormer Roof	2.3300		2.3300	0.3000	0.6990	9.0000	20.9700 (30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.2045		(33)
GF			64.1200			9.0000	577.0800 (32c)
FF			70.8400			9.0000	637.5600 (32c)
2F			60.0600			9.0000	540.5400 (32c)
Internal Floor 1			26.6000			18.0000	478.8000 (32d)
Internal Floor 2			26.6000			18.0000	478.8000 (32d)
Internal Floor 1			26.6000			18.0000	478.8000 (32e)
Internal Floor 2			26.6000			18.0000	478.8000 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16364.1900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2678 (36)
Total fabric heat loss					(33) + (36) =		96.4723 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	56.3786	56.0716	55.7707	54.3572	54.0928	52.8617	52.8617	52.6337	53.3359	54.0928	54.6278	55.1871 (38)
Average = Sum(39)m / 12 =	152.8510	152.5440	152.2430	150.8295	150.5651	149.3340	149.3340	149.1060	149.8082	150.5651	151.1001	151.6594 (39)
												150.8283 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2608	1.2583	1.2558	1.2442	1.2420	1.2318	1.2318	1.2299	1.2357	1.2420	1.2464	1.2510 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8679 (42)
Average daily hot water use (litres/day)												102.3137 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)
Energy content	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)	Total = Sum(45)m =											1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0352	21.8959	22.5946	19.6985	18.9012	16.3103	15.1139	17.3434	17.5506	20.4535	22.3266	24.2452 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	21.0813	19.0206	21.0113	20.2714	20.8847	20.1372	20.7626	20.8418	20.2098	20.9499	20.3467	21.0586 (61)
Total heat required for water heating calculated for each month	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (64)
	Total per year (kWh/year) = Sum(64)m =											1856.3683 (64)
Heat gains from water heating, kWh/month	60.7649	53.2911	55.3376	48.7329	47.1189	41.1888	38.6931	43.6550	43.9562	50.5760	54.5772	59.0082 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.1698	23.2438	18.9031	14.3109	10.6976	9.0313	9.7587	12.6847	17.0254	21.6176	25.2309	26.8972 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	286.8059	289.7820	282.2823	266.3161	246.1616	227.2193	214.5647	211.5885	219.0883	235.0545	255.2089	274.1513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Water heating gains (Table 5)	81.6733	79.3022	74.3784	67.6846	63.3318	57.2067	52.0069	58.6761	61.0503	67.9785	75.8017	79.3121 (72)
Total internal gains	463.6681	461.3472	444.5830	417.3307	389.2102	362.4765	345.3494	351.9685	366.1831	393.6698	425.2608	449.3797 (73)

6. Solar gains

[Jan]						Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast						2.1700	11.2829	0.6200	0.7000	0.7700	7.3639 (75)	
Southeast						5.2700	36.7938	0.6200	0.7000	0.7700	58.3188 (77)	
Southwest						2.1100	36.7938	0.6200	0.7000	0.7700	23.3497 (79)	
Northwest						7.0100	11.2829	0.6200	0.7000	0.7700	23.7883 (81)	
Southeast						3.1500	36.7938	0.6200	0.7000	0.7700	34.8585 (77)	
Southeast						1.5200	39.9751	0.6300	0.7000	1.0000	24.1165 (82)	
Solar gains	171.7956	306.2310	453.4628	616.9200	739.2946	754.6671	718.9960	624.8780	509.8068	347.9032	208.2884	145.3709 (83)
Total gains	635.4638	767.5782	898.0458	1034.2508	1128.5048	1117.1436	1064.3454	976.8465	875.9899	741.5730	633.5491	594.7506 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	29.7388	29.7987	29.8576	30.1374	30.1903	30.4392	30.4392	30.4857	30.3429	30.1903	30.0834	29.9725
alpha	2.9826	2.9866	2.9905	3.0092	3.0127	3.0293	3.0293	3.0324	3.0229	3.0127	3.0056	2.9982
util living area	0.9881	0.9785	0.9586	0.9126	0.8251	0.6905	0.5534	0.6079	0.8098	0.9417	0.9808	0.9902 (86)
MIT	18.7287	18.9867	19.4086	19.9553	20.4435	20.7806	20.9190	20.8905	20.6146	19.9709	19.2478	18.6820 (87)
Th 2	19.8716	19.8736	19.8756	19.8848	19.8866	19.8946	19.8946	19.8961	19.8915	19.8866	19.8831	19.8794 (88)
util rest of house	0.9857	0.9741	0.9498	0.8928	0.7829	0.6112	0.4371	0.4934	0.7478	0.9246	0.9762	0.9882 (89)
MIT 2	16.8405	17.2163	17.8274	18.6112	19.2800	19.7066	19.8480	19.8276	19.5216	18.6485	17.6045	16.7768 (90)
Living area fraction	fLA = Living area / (4) = 0.1666 (91)											
MIT	17.1551	17.5113	18.0909	18.8352	19.4738	19.8856	20.0265	20.0047	19.7037	18.8688	17.8783	17.0943 (92)
Temperature adjustment	-0.1500											
adjusted MIT	17.0051	17.3613	17.9409	18.6852	19.3238	19.7356	19.8765	19.8547	19.5537	18.7188	17.7283	16.9443 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9757	0.9592	0.9281	0.8649	0.7571	0.5982	0.4350	0.4886	0.7246	0.8992	0.9621	0.9796 (94)

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Useful gains	620.0094	736.2348	833.4524	894.5068	854.4420	668.3242	463.0390	477.2765	634.7856	666.7964	609.5390	582.6187 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1941.9855	1900.8893	1741.7932	1475.8954	1147.8838	766.9173	489.2902	515.1118	817.0088	1222.4116	1605.9351	1932.7913 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	983.5502	782.6478	675.8056	418.5998	218.3207	0.0000	0.0000	0.0000	0.0000	413.3777	717.4052	1004.5284 (98)
Space heating												5214.2354 (98)
Space heating per m2											(98) / (4) =	43.0111 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.0000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												5793.5949 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	983.5502	782.6478	675.8056	418.5998	218.3207	0.0000	0.0000	0.0000	0.0000	413.3777	717.4052	1004.5284 (98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)	1092.8336	869.6087	750.8951	465.1109	242.5786	0.0000	0.0000	0.0000	0.0000	459.3086	797.1169	1116.1427 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (64)
Efficiency of water heater	89.4537	89.4075	89.3115	89.0984	88.6430	86.7000	86.7000	86.7000	86.7000	89.0656	89.3510	86.7000 (216)
(217)m	89.4537	89.4075	89.3115	89.0984	88.6430	86.7000	86.7000	86.7000	86.7000	89.0656	89.3510	89.4759 (217)
Fuel for water heating, kWh/month	210.1449	184.5408	192.1836	170.1433	165.7128	148.6420	140.1636	157.3985	158.2624	176.6187	189.3549	204.1816 (219)
Water heating fuel used												2097.3474 (219)
Annual totals kWh/year												
Space heating fuel - main system												5793.5949 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												75.0000 (231)
Electricity for lighting (calculated in Appendix L)												462.1671 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 1004 * 1.00) =										-650.5895		-650.5895 (233)
Total delivered energy for all uses												7777.5198 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5793.5949	0.2160	1251.4165 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2097.3474	0.2160	453.0270 (264)
Space and water heating			1704.4435 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	462.1671	0.5190	239.8647 (268)
Energy saving/generation technologies			
PV Unit	-650.5895	0.5190	-337.6560 (269)
Total CO2, kg/year			1645.5773 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.5700 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER			13.5700 ZC1
Total Floor Area		TFA	121.2300
Assumed number of occupants		N	2.8679
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			14.0192 ZC2
CO2 emissions from cooking, equation (L16)			1.5494 ZC3
Total CO2 emissions			29.1386 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			29.1386 ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3862 (18)
Number of sides sheltered					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3282 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4185	0.4103	0.4021	0.3611	0.3529	0.3118	0.3118	0.3036	0.3282	0.3529	0.3693	0.3857 (22b)
Effective ac	0.5876	0.5842	0.5808	0.5652	0.5623	0.5486	0.5486	0.5461	0.5539	0.5623	0.5682	0.5744 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1300	1.0000	2.1300		(26)
TER Opening Type (Uw = 1.40)			19.7100	1.3258	26.1307		(27)
TER Room Window (Uw = 1.70)			1.5200	1.5918	2.4195		(27a)
Jet Floor Lo			43.5000	0.1300	5.6550		(28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.1800	26.5608		(29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.1800	0.6822		(29a)
Wall to Void	14.5300		14.5300	0.1800	2.6154		(29a)
Plane	22.8000		22.8000	0.1300	2.9640		(30)
Sloping	13.9200	1.5200	12.4000	0.1300	1.6120		(30)
Bay	0.9700		0.9700	0.1300	0.1261		(30)
Ceiling to Void	7.3700		7.3700	0.1300	0.9581		(30)
Dormer Roof	2.3300		2.3300	0.1300	0.3029		(30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1567		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.2903 (36)
Total fabric heat loss						(33) + (36) =	86.4470 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	56.9619	56.6322	56.3091	54.7913	54.5073	53.1854	53.1854	52.9406	53.6946	54.5073	55.0818	55.6824 (38)
Heat transfer coeff	143.4088	143.0792	142.7560	141.2383	140.9543	139.6324	139.6324	139.3876	140.1416	140.9543	141.5288	142.1293 (39)
Average = Sum(39)m / 12 =												141.2369 (39)
HLP	1.1829	1.1802	1.1776	1.1650	1.1627	1.1518	1.1518	1.1498	1.1560	1.1627	1.1674	1.1724 (40)
HLP (average)												1.1650 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8679 (42)
Average daily hot water use (litres/day)												102.3137 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)

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Energy conte	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)										Total =	Sum (45)m =	1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.0352	21.8959	22.5946	19.6985	18.9012	16.3103	15.1139	17.3434	17.5506	20.4535	22.3266	24.2452 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	49.0096	45.4105	46.9241	49.0096	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	217.8599	192.0001	201.5897	180.6386	175.0177	154.1458	147.6835	164.6324	166.3188	187.3154	198.1589	212.5936 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) =	Sum (63)m =			0.0000 (63)
Output from w/h												
	217.8599	192.0001	201.5897	180.6386	175.0177	154.1458	147.6835	164.6324	166.3188	187.3154	198.1589	212.5936 (64)
Heat gains from water heating, kWh/month								Total per year (kWh/year) =	Sum (64)m =			2197.9545 (64)
	68.2343	60.0428	62.8245	55.9938	54.1501	47.5071	45.2335	50.6970	51.2325	58.0783	61.8193	66.4833 (65)

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

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	26.1698	23.2438	18.9031	14.3109	10.6976	9.0313	9.7587	12.6847	17.0254	21.6176	25.2309	26.8972 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	286.8059	289.7820	282.2823	266.3161	246.1616	227.2193	214.5647	211.5885	219.0883	235.0545	255.2089	274.1513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Water heating gains (Table 5)												
	91.7128	89.3494	84.4415	77.7692	72.7824	65.9821	60.7977	68.1411	71.1562	78.0622	85.8602	89.3592 (72)
Total internal gains												
	473.7077	471.3944	454.6460	427.4153	398.6607	371.2519	354.1402	361.4335	376.2891	403.7535	435.3192	459.4268 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W
Northeast					2.1700	11.2829	0.6300	0.7000	0.7700			7.4826 (75)
Southeast					8.4200	36.7938	0.6300	0.7000	0.7700			94.6802 (77)
Southwest					2.1100	36.7938	0.6300	0.7000	0.7700			23.7263 (79)
Northwest					7.0100	11.2829	0.6300	0.7000	0.7700			24.1720 (81)
Southeast					1.5200	39.9751	0.6300	0.7000	1.0000			24.1165 (82)
Solar gains	174.1775	310.4552	459.6859	625.3737	749.4416	765.0391	728.8716	633.4446	516.7952	352.6913	211.1717	147.3897 (83)
Total gains	647.8852	781.8496	914.3319	1052.7890	1148.1024	1136.2910	1083.0118	994.8781	893.0842	756.4448	646.4910	606.8165 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.7046	58.8398	58.9730	59.6067	59.7268	60.2922	60.2922	60.3981	60.0732	59.7268	59.4844	59.2330
alpha	4.9136	4.9227	4.9315	4.9738	4.9818	5.0195	5.0195	5.0265	5.0049	4.9818	4.9656	4.9489
util living area	0.9988	0.9968	0.9900	0.9635	0.8829	0.7207	0.5525	0.6174	0.8648	0.9817	0.9973	0.9992 (86)
MIT	19.6541	19.8256	20.1022	20.4633	20.7702	20.9421	20.9876	20.9791	20.8494	20.4410	19.9787	19.6255 (87)
Th 2	19.9337	19.9358	19.9380	19.9481	19.9500	19.9588	19.9588	19.9604	19.9554	19.9500	19.9461	19.9421 (88)
util rest of house	0.9984	0.9956	0.9863	0.9492	0.8381	0.6285	0.4293	0.4911	0.7963	0.9722	0.9962	0.9989 (89)
MIT 2	18.1345	18.3866	18.7903	19.3132	19.7228	19.9200	19.9542	19.9517	19.8314	19.2905	18.6182	18.0987 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	18.3877	18.6264	19.0089	19.5048	19.8973	20.0903	20.1264	20.1229	20.0010	19.4822	18.8449	18.3531 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3877	18.6264	19.0089	19.5048	19.8973	20.0903	20.1264	20.1229	20.0010	19.4822	18.8449	18.3531 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9975	0.9935	0.9817	0.9414	0.8355	0.6411	0.4499	0.5119	0.7999	0.9662	0.9944	0.9981 (94)
Useful gains	646.2365	776.7750	897.5775	991.1197	959.2070	728.4579	487.2175	509.3144	714.3420	730.8593	642.8463	605.6901 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W												
	2020.3023	1963.9624	1785.7207	1497.8049	1155.4516	766.6280	492.3999	518.9250	826.9727	1251.9876	1662.2407	2011.5731 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	1022.3050	797.7899	660.7786	364.8134	146.0060	0.0000	0.0000	0.0000	0.0000	387.7195	733.9640	1045.9769 (98)
Space heating												5159.3532 (98)
Space heating per m ²										(98) / (4) =		42.5584 (99)

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8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5523.9328 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1022.3050	797.7899	660.7786	364.8134	146.0060	0.0000	0.0000	0.0000	0.0000	387.7195	733.9640	1045.9769	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	1094.5450	854.1648	707.4717	390.5925	156.3234	0.0000	0.0000	0.0000	0.0000	415.1172	785.8287	1119.8896	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	217.8599	192.0001	201.5897	180.6386	175.0177	154.1458	147.6835	164.6324	166.3188	187.3154	198.1589	212.5936	(64)
Efficiency of water heater	88.4457	88.2469	87.8180	86.7850	84.5988	80.3000	80.3000	80.3000	80.3000	86.8419	88.0457	88.5193	(216)
Fuel for water heating, kWh/month	246.3204	217.5715	229.5541	208.1449	206.8796	191.9624	183.9146	205.0217	207.1217	215.6970	225.0636	240.1664	(219)
Water heating fuel used												2577.4180	(219)
Annual totals kWh/year													
Space heating fuel - main system												5523.9328	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												462.1671	(232)
Total delivered energy for all uses												8638.5179	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5523.9328	0.2160	1193.1695 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2577.4180	0.2160	556.7223 (264)
Space and water heating			1749.8918 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	462.1671	0.5190	239.8647 (268)
Total CO2, kg/m2/year			2028.6815 (272)
Emissions per m2 for space and water heating			14.4345 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.9786 (272b)
Emissions per m2 for pumps and fans			0.3211 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.4345 * 1.00) + 1.9786 + 0.3211, rounded to 2 d.p.			16.7300 (273)

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Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-180				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)			
Property	6, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	88 B	DER	13.57	TER	16.73	
Environmental	88 B	% DER<TER	18.91			
CO ₂ Emissions (t/year)	1.31	DFEE	50.26	TFEE	54.74	
General Requirements Compliance	Pass	% DFEE<TFEE	8.18			
Assessor	Silvio Junges, Tel: 01884 242050				Assessor ID	P637-0001
Client						

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.7300
Infiltration rate					0.3727 (18)
Number of sides sheltered					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3168 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4039	0.3960	0.3880	0.3484	0.3405	0.3009	0.3009	0.2930	0.3168	0.3405	0.3564	0.3722 (22b)
Effective ac	0.5816	0.5784	0.5753	0.5607	0.5580	0.5453	0.5453	0.5429	0.5502	0.5580	0.5635	0.5693 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			16.5600	1.3258	21.9545		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Roof Lights (Uw = 1.60)			1.5200	1.5038	2.2857		(27a)
Jet Floor Lo			43.5000	0.1800	7.8300	75.0000	3262.5000 (28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.2500	36.8900	60.0000	8853.6000 (29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.3000	1.1370	9.0000	34.1100 (29a)
Wall to Void	14.5300		14.5300	0.1600	2.3248	9.0000	130.7700 (29a)
Plane	22.8000		22.8000	0.1300	2.9640	9.0000	205.2000 (30)
Sloping	13.9200	1.5200	12.4000	0.1600	1.9840	9.0000	111.6000 (30)
Bay	0.9700		0.9700	0.1300	0.1261	9.0000	8.7300 (30)
Ceiling to Void	7.3700		7.3700	0.2600	1.9162	9.0000	66.3300 (30)
Dormer Roof	2.3300		2.3300	0.3000	0.6990	9.0000	20.9700 (30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		86.2045		(33)
GF			64.1200			9.0000	577.0800 (32c)
FF			70.8400			9.0000	637.5600 (32c)
2F			60.0600			9.0000	540.5400 (32c)
Internal Floor 1			26.6000			18.0000	478.8000 (32d)

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Internal Floor 2	26.6000	18.0000	478.8000 (32d)
Internal Floor 1	26.6000	9.0000	239.4000 (32e)
Internal Floor 2	26.6000	9.0000	239.4000 (32e)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 15885.3900 (34)
 Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 131.0351 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.2678 (36)
 Total fabric heat loss (33) + (36) = 96.4723 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	56.3786	56.0716	55.7707	54.3572	54.0928	52.8617	52.8617	52.6337	53.3359	54.0928	54.6278	55.1871 (38)
Average = Sum(39)m / 12 =	152.8510	152.5440	152.2430	150.8295	150.5651	149.3340	149.3340	149.1060	149.8082	150.5651	151.1001	151.6594 (39)
												150.8283 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2608	1.2583	1.2558	1.2442	1.2420	1.2318	1.2318	1.2299	1.2357	1.2420	1.2464	1.2510 (40)
Days in month												1.2441 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												
Average daily hot water use (litres/day)												2.8679 (42)
												102.3137 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)
Energy conte	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)												Total = Sum(45)m = 1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	35.4665	31.0192	32.0090	27.9063	26.7767	23.1063	21.4114	24.5698	24.8633	28.9758	31.6293	34.3474 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	26.1698	23.2438	18.9031	14.3109	10.6976	9.0313	9.7587	12.6847	17.0254	21.6176	25.2309	26.8972 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	286.8059	289.7820	282.2823	266.3161	246.1616	227.2193	214.5647	211.5885	219.0883	235.0545	255.2089	274.1513 (68)
Pumps, fans	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397 (69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Water heating gains (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Total internal gains	47.6700	46.1595	43.0229	38.7587	35.9902	32.0920	28.7787	33.0240	34.5323	38.9459	43.9296	46.1658 (72)
	426.6649	425.2045	410.2274	385.4048	358.8686	334.3618	319.1212	323.3164	336.6652	361.6372	390.3886	413.2334 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W			
Northeast					2.1700	11.2829		0.6200	0.7000		0.7700		7.3639 (75)			
Southeast					5.2700	36.7938		0.6200	0.7000		0.7700		58.3188 (77)			
Southwest					2.1100	36.7938		0.6200	0.7000		0.7700		23.3497 (79)			
Northwest					7.0100	11.2829		0.6200	0.7000		0.7700		23.7883 (81)			
Southeast					3.1500	36.7938		0.6200	0.7000		0.7700		34.8585 (77)			
Southeast					1.5200	39.9751		0.6300	0.7000		1.0000		24.1165 (82)			
Solar gains					171.7956	306.2310	453.4628	616.9200	739.2946	754.6671	718.9960	624.8780	509.8068	347.9032	208.2884	145.3709 (83)
Total gains					598.4605	731.4356	863.6903	1002.3248	1098.1632	1089.0289	1038.1172	948.1944	846.4720	709.5404	598.6770	558.6043 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	28.8687	28.9268	28.9840	29.2556	29.3070	29.5486	29.5486	29.5938	29.4551	29.3070	29.2032	29.0955
util living area	2.9246	2.9285	2.9323	2.9504	2.9538	2.9699	2.9699	2.9729	2.9637	2.9538	2.9469	2.9397
	0.9890	0.9796	0.9602	0.9151	0.8295	0.6974	0.5616	0.6178	0.8169	0.9448	0.9822	0.9910 (86)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

MIT	18.6413	18.9061	19.3397	19.9028	20.4083	20.7620	20.9102	20.8785	20.5854	19.9170	19.1734	18.5943 (87)
Th 2	19.8716	19.8736	19.8756	19.8848	19.8866	19.8946	19.8946	19.8961	19.8915	19.8866	19.8831	18.8794 (88)
util rest of house												
	0.9867	0.9755	0.9518	0.8961	0.7885	0.6192	0.4453	0.5037	0.7569	0.9287	0.9779	0.9891 (89)
MIT 2	17.7188	17.9829	18.4128	18.9678	19.4430	19.7535	19.8586	19.8431	19.6165	18.9925	18.2572	17.6775 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	17.8726	18.1367	18.5673	19.1236	19.6039	19.9215	20.0338	20.0156	19.7780	19.1465	18.4098	17.8302 (92)
Temperature adjustment												0.0000
adjusted MIT	17.8726	18.1367	18.5673	19.1236	19.6039	19.9215	20.0338	20.0156	19.7780	19.1465	18.4098	17.8302 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9668	0.9389	0.8799	0.7763	0.6213	0.4612	0.5174	0.7495	0.9146	0.9700	0.9843 (94)	
Useful gains	587.1475	707.1415	810.9316	881.9466	852.4631	676.6417	478.7710	490.5497	634.4546	648.9320	580.7102	549.8491 (95)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)	
Heat loss rate W													
	2074.5784	2019.1861	1837.1547	1542.0255	1190.0456	794.6880	512.7846	539.1114	850.6084	1286.8108	1708.9192	2067.1518 (97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (98)	
Space heating kWh													
	1106.6486	881.6940	763.5099	475.2568	251.1614	0.0000	0.0000	0.0000	0.0000	474.5818	812.3105	1128.8732 (98)	
Space heating												5894.0362 (98)	
Space heating per m2												48.6186 (99)	

(98) / (4) =

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1403.7395	1105.0715	1133.2056	0.0000	0.0000	0.0000	0.0000 (100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7388	0.8073	0.7715	0.0000	0.0000	0.0000	0.0000 (101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1037.0650	892.1603	874.3166	0.0000	0.0000	0.0000	0.0000 (102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1369.4742	1308.2242	1207.5232	0.0000	0.0000	0.0000	0.0000 (103)	
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)	
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	239.3346	309.5515	247.9058	0.0000	0.0000	0.0000	0.0000 (104)	
Space cooling												796.7919 (104)	
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)	
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)	
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	59.8337	77.3879	61.9764	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												199.1980 (107)	
Space cooling per m2												1.6431 (108)	
Energy for space heating												48.6186 (99)	
Energy for space cooling												1.6431 (108)	
Total												50.2618 (109)	
Dwelling Fabric Energy Efficiency (DFEE)												50.3 (109)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3862 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3282 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4185	0.4103	0.4021	0.3611	0.3529	0.3118	0.3118	0.3036	0.3282	0.3529	0.3693	0.3857 (22b)
Effective ac	0.5876	0.5842	0.5808	0.5652	0.5623	0.5486	0.5486	0.5461	0.5539	0.5623	0.5682	0.5744 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1300	1.0000	2.1300		(26)
TER Opening Type (Uw = 1.40)			19.7100	1.3258	26.1307		(27)
TER Room Window (Uw = 1.70)			1.5200	1.5918	2.4195		(27a)
Jet Floor Lo			43.5000	0.1300	5.6550		(28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.1800	26.5608		(29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.1800	0.6822		(29a)
Wall to Void	14.5300		14.5300	0.1800	2.6154		(29a)
Plane	22.8000		22.8000	0.1300	2.9640		(30)
Sloping	13.9200	1.5200	12.4000	0.1300	1.6120		(30)
Bay	0.9700		0.9700	0.1300	0.1261		(30)
Ceiling to Void	7.3700		7.3700	0.1300	0.9581		(30)
Dormer Roof	2.3300		2.3300	0.1300	0.3029		(30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.1567		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.2903 (36)
Total fabric heat loss						(33) + (36) =	86.4470 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 56.9619	Feb 56.6322	Mar 56.3091	Apr 54.7913	May 54.5073	Jun 53.1854	Jul 53.1854	Aug 52.9406	Sep 53.6946	Oct 54.5073	Nov 55.0818	Dec 55.6824 (38)
Heat transfer coeff	143.4088	143.0792	142.7560	141.2383	140.9543	139.6324	139.6324	139.3876	140.1416	140.9543	141.5288	142.1293 (39)
Average = Sum(39)m / 12 =												141.2369 (39)
HLP	Jan 1.1829	Feb 1.1802	Mar 1.1776	Apr 1.1650	May 1.1627	Jun 1.1518	Jul 1.1518	Aug 1.1498	Sep 1.1560	Oct 1.1627	Nov 1.1674	Dec 1.1724 (40)
HLP (average)												1.1650 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8679 (42)
Average daily hot water use (litres/day)												102.3137 (43)
Daily hot water use	Jan 112.5450	Feb 108.4525	Mar 104.3599	Apr 100.2674	May 96.1748	Jun 92.0823	Jul 92.0823	Aug 96.1748	Sep 100.2674	Oct 104.3599	Nov 108.4525	Dec 112.5450 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)										Total =	Sum (45)m =	1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.4665	31.0192	32.0090	27.9063	26.7767	23.1063	21.4114	24.5698	24.8633	28.9758	31.6293	34.3474 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972	143.3972 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.1698	23.2438	18.9031	14.3109	10.6976	9.0313	9.7587	12.6847	17.0254	21.6176	25.2309	26.8972 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	286.8059	289.7820	282.2823	266.3161	246.1616	227.2193	214.5647	211.5885	219.0883	235.0545	255.2089	274.1513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397	37.3397 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Water heating gains (Table 5)	47.6700	46.1595	43.0229	38.7587	35.9902	32.0920	28.7787	33.0240	34.5323	38.9459	43.9296	46.1658 (72)
Total internal gains	426.6649	425.2045	410.2274	385.4048	358.8686	334.3618	319.1212	323.3164	336.6652	361.6372	390.3886	413.2334 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	2.1700	11.2829	0.6300	0.7000	0.7700	7.4826 (75)
Southeast	8.4200	36.7938	0.6300	0.7000	0.7700	94.6802 (77)
Southwest	2.1100	36.7938	0.6300	0.7000	0.7700	23.7263 (79)
Northwest	7.0100	11.2829	0.6300	0.7000	0.7700	24.1720 (81)
Southeast	1.5200	39.9751	0.6300	0.7000	1.0000	24.1165 (82)

Solar gains	174.1775	310.4552	459.6859	625.3737	749.4416	765.0391	728.8716	633.4446	516.7952	352.6913	211.1717	147.3897 (83)
Total gains	600.8424	735.6598	869.9133	1010.7785	1108.3102	1099.4009	1047.9928	956.7610	853.4603	714.3285	601.5604	560.6231 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.7046	58.8398	58.9730	59.6067	59.7268	60.2922	60.2922	60.3981	60.0732	59.7268	59.4844	59.2330
alpha	4.9136	4.9227	4.9315	4.9738	4.9818	5.0195	5.0195	5.0265	5.0049	4.9818	4.9656	4.9489
util living area	0.9992	0.9975	0.9919	0.9687	0.8943	0.7374	0.5689	0.6377	0.8809	0.9855	0.9981	0.9994 (86)
MIT	19.6180	19.7906	20.0695	20.4361	20.7529	20.9358	20.9859	20.9759	20.8335	20.4111	19.9445	19.5900 (87)
Th 2	19.9337	19.9358	19.9380	19.9481	19.9500	19.9588	19.9588	19.9604	19.9554	19.9500	19.9461	19.9421 (88)
util rest of house	0.9989	0.9967	0.9888	0.9561	0.8522	0.6456	0.4431	0.5093	0.8167	0.9778	0.9972	0.9992 (89)
MIT 2	18.6693	18.8433	19.1223	19.4891	19.7812	19.9290	19.9552	19.9534	19.8597	19.4712	19.0054	18.6481 (90)
Living area fraction	18.8274	19.0011	19.2802	19.6469	19.9431	20.0967	20.1269	20.1238	20.0220	19.6278	19.1619	18.8050 (92)
Temperature adjustment	18.8274	19.0011	19.2802	19.6469	19.9431	20.0967	20.1269	20.1238	20.0220	19.6278	19.1619	18.8050 (93)
adjusted MIT	18.8274	19.0011	19.2802	19.6469	19.9431	20.0967	20.1269	20.1238	20.0220	19.6278	19.1619	18.8050 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	599.8920	732.3943	857.9656	961.7660	944.1195	724.4125	486.5162	507.7898	701.2007	696.1011	599.3619	559.9941 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	2083.3582	2017.5746	1824.4460	1517.8781	1161.8975	767.5240	492.4741	519.0517	829.9165	1272.5045	1707.1013	2075.8031 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	1103.6989	863.6412	719.0614	400.4007	162.0269	0.0000	0.0000	0.0000	0.0000	428.8442	797.5724	1127.7619 (98)
Space heating												5603.0074 (98)
Space heating per m2										(98) / (4) =		46.2180 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1312.5445	1033.2797	1059.3458	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8545	0.9175	0.8863	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1121.5616	948.0820	938.9113	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1381.5973	1319.7670	1217.5362	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	187.2257	276.5337	207.2969	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									FC = cooled area / (4) =			671.0563	(104)
Intermittency factor (Table 10b)												1.0000	(105)
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	46.8064	69.1334	51.8242	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													
Space cooling per m2												167.7641	(107)
Energy for space heating												1.3838	(108)
Energy for space cooling												46.2180	(99)
Total												1.3838	(108)
Target Fabric Energy Efficiency (TFEE)												47.6018	(109)
												54.7	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-180				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)			
Property	6, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	88 B	DER	13.57	TER	16.73	
Environmental	88 B	% DER<TER	18.91			
CO ₂ Emissions (t/year)	1.31	DFEE	50.26	TFEE	54.74	
General Requirements Compliance	Pass	% DFEE<TFEE	8.18			
Assessor	Silvio Junges, Tel: 01884 242050				Assessor ID	P637-0001
Client						

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.7300
Infiltration rate					0.3727 (18)
Number of sides sheltered					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3168 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3326	0.3088	0.3168	0.3009	0.3009	0.2930	0.2851	0.2772	0.2692	0.2930	0.2772	0.2930 (22b)
Effective ac	0.5553	0.5477	0.5502	0.5453	0.5453	0.5429	0.5406	0.5384	0.5362	0.5429	0.5384	0.5429 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			16.5600	1.3258	21.9545		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Roof Lights (Uw = 1.60)			1.5200	1.5038	2.2857		(27a)
Jet Floor Lo			43.5000	0.1800	7.8300	75.0000	3262.5000 (28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.2500	36.8900	60.0000	8853.6000 (29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.3000	1.1370	9.0000	34.1100 (29a)
Wall to Void	14.5300		14.5300	0.1600	2.3248	9.0000	130.7700 (29a)
Plane	22.8000		22.8000	0.1300	2.9640	9.0000	205.2000 (30)
Sloping	13.9200	1.5200	12.4000	0.1600	1.9840	9.0000	111.6000 (30)
Bay	0.9700		0.9700	0.1300	0.1261	9.0000	8.7300 (30)
Ceiling to Void	7.3700		7.3700	0.2600	1.9162	9.0000	66.3300 (30)
Dormer Roof	2.3300		2.3300	0.3000	0.6990	9.0000	20.9700 (30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		86.2045		(33)
GF			64.1200			9.0000	577.0800 (32c)
FF			70.8400			9.0000	637.5600 (32c)
2F			60.0600			9.0000	540.5400 (32c)
Internal Floor 1			26.6000			18.0000	478.8000 (32d)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Internal Floor 2	26.6000	18.0000	478.8000 (32d)
Internal Floor 1	26.6000	18.0000	478.8000 (32e)
Internal Floor 2	26.6000	18.0000	478.8000 (32e)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 16364.1900 (34)
 Thermal mass parameter (TMP = C_m / TFA) in kJ/m2K 134.9847 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.2678 (36)
 Total fabric heat loss (33) + (36) = 96.4723 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	53.8344	53.0957	53.3359	52.8617	52.8617	52.6337	52.4118	52.1960	51.9862	52.6337	52.1960	52.6337 (38)
Average = Sum(39)m / 12 =	150.3067	149.5680	149.8082	149.3340	149.3340	149.1060	148.8841	148.6683	148.4585	149.1060	148.6683	149.1060 (39)
												149.1957 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2398	1.2338	1.2357	1.2318	1.2318	1.2299	1.2281	1.2263	1.2246	1.2299	1.2263	1.2299 (40)
Days in month												1.2307 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8679 (42)
 Average daily hot water use (litres/day) 102.3137 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)
Energy content (annual)	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0352	21.8959	22.5946	19.6985	18.9012	16.3103	15.1139	17.3434	17.5506	20.4535	22.3266	24.2452 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	21.0813	19.0206	21.0113	20.2714	20.8847	20.1372	20.7626	20.8418	20.2098	20.9499	20.3467	21.0586 (61)
Total heat required for water heating calculated for each month	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	60.7649	53.2911	55.3376	48.7329	47.1189	41.1888	38.6931	43.6550	43.9562	50.5760	54.5772	59.0082 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	65.4245	58.1095	47.2578	35.7772	26.7439	22.5783	24.3967	31.7117	42.5634	54.0440	63.0773	67.2429 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	428.0685	432.5105	421.3168	397.4867	367.4054	339.1333	320.2458	315.8038	326.9975	350.8276	380.9089	409.1810 (68)
Pumps, fans	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Total internal gains	81.6733	79.3022	74.3784	67.6846	63.3318	57.2067	52.0069	58.6761	61.0503	67.9785	75.8017	79.3121 (72)
	690.6008	685.3567	658.3875	616.3830	572.9156	534.3528	512.0838	521.6261	546.0456	588.2846	635.2224	671.1705 (73)

6. Solar gains

[Jan]						Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast						2.1700	14.6176	0.6200	0.7000	0.7700	9.5403 (75)	
Southeast						5.2700	45.1778	0.6200	0.7000	0.7700	71.6076 (77)	
Southwest						2.1100	45.1778	0.6200	0.7000	0.7700	28.6702 (79)	
Northwest						7.0100	14.6176	0.6200	0.7000	0.7700	30.8190 (81)	
Southeast						3.1500	45.1778	0.6200	0.7000	0.7700	42.8015 (77)	
Southeast						1.5200	50.2544	0.6300	0.7000	1.0000	30.3179 (82)	
Solar gains	213.7564	325.2246	488.0516	672.0283	768.0979	852.6291	805.6153	715.6886	580.9519	399.3653	258.5118	177.6882 (83)
Total gains	904.3572	1010.5813	1146.4392	1288.4112	1341.0135	1386.9819	1317.6991	1237.3147	1126.9975	987.6499	893.7342	848.8587 (84)

7. Mean internal temperature (heating season)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.2422	30.3916	30.3429	30.4392	30.4392	30.4857	30.5312	30.5755	30.6187	30.4857	30.5755	30.4857
alpha	3.0161	3.0261	3.0229	3.0293	3.0293	3.0324	3.0354	3.0384	3.0412	3.0324	3.0384	3.0324
util living area	0.9672	0.9540	0.9199	0.8475	0.7308	0.5504	0.4194	0.4425	0.6786	0.8703	0.9470	0.9715 (86)
MIT	19.1659	19.3543	19.7609	20.2560	20.6558	20.8970	20.9666	20.9615	20.7968	20.3194	19.6879	19.1420 (87)
Th 2	19.8883	19.8931	19.8915	19.8946	19.8946	19.8961	19.8976	19.8990	19.9004	19.8961	19.8990	19.8961 (88)
util rest of house	0.9608	0.9453	0.9042	0.8169	0.6748	0.4628	0.3095	0.3281	0.5978	0.8365	0.9349	0.9659 (89)
MIT 2	17.4824	17.7557	18.3345	19.0238	19.5472	19.8205	19.8824	19.8812	19.7288	19.1279	18.2441	17.4534 (90)
Living area fraction	fLA = Living area / (4) =											0.1666 (91)
MIT	17.7629	18.0221	18.5722	19.2291	19.7319	19.9998	20.0630	20.0612	19.9068	19.3264	18.4847	17.7347 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6129	17.8721	18.4222	19.0791	19.5819	19.8498	19.9130	19.9112	19.7568	19.1764	18.3347	17.5847 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9420	0.9230	0.8771	0.7896	0.6568	0.4589	0.3111	0.3294	0.5860	0.8087	0.9110	0.9485 (94)
Useful gains	851.8637	932.7996	1005.5654	1017.3899	880.7772	636.4310	409.9200	407.5758	660.3731	798.7103	814.2348	805.1316 (95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W	1910.8338	1880.3826	1711.1374	1430.4917	1057.5707	678.4070	418.8157	417.9362	750.7186	1159.5134	1551.3076	1876.4604 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	787.8738	636.7758	524.9456	297.4333	131.5344	0.0000	0.0000	0.0000	0.0000	268.4375	530.6924	797.0686 (98)
Space heating												3974.7615 (98)
RHI space heating demand												3975 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.7300
Infiltration rate					0.3727 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3168 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4039	0.3960	0.3880	0.3484	0.3405	0.3009	0.3009	0.2930	0.3168	0.3405	0.3564	0.3722 (22b)
Effective ac	0.5816	0.5784	0.5753	0.5607	0.5580	0.5453	0.5453	0.5429	0.5502	0.5580	0.5635	0.5693 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			16.5600	1.3258	21.9545		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Roof Lights (Uw = 1.60)			1.5200	1.5038	2.2857		(27a)
Jet Floor Lo			43.5000	0.1800	7.8300	75.0000	3262.5000 (28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.2500	36.8900	60.0000	8853.6000 (29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.3000	1.1370	9.0000	34.1100 (29a)
Wall to Void	14.5300		14.5300	0.1600	2.3248	9.0000	130.7700 (29a)
Plane	22.8000		22.8000	0.1300	2.9640	9.0000	205.2000 (30)
Sloping	13.9200	1.5200	12.4000	0.1600	1.9840	9.0000	111.6000 (30)
Bay	0.9700		0.9700	0.1300	0.1261	9.0000	8.7300 (30)
Ceiling to Void	7.3700		7.3700	0.2600	1.9162	9.0000	66.3300 (30)
Dormer Roof	2.3300		2.3300	0.3000	0.6990	9.0000	20.9700 (30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.2045		(33)
GF			64.1200			9.0000	577.0800 (32c)
FF			70.8400			9.0000	637.5600 (32c)
2F			60.0600			9.0000	540.5400 (32c)
Internal Floor 1			26.6000			18.0000	478.8000 (32d)
Internal Floor 2			26.6000			18.0000	478.8000 (32d)
Internal Floor 1			26.6000			18.0000	478.8000 (32e)
Internal Floor 2			26.6000			18.0000	478.8000 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16364.1900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2678 (36)
Total fabric heat loss						(33) + (36) =	96.4723 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	56.3786	56.0716	55.7707	54.3572	54.0928	52.8617	52.8617	52.6337	53.3359	54.0928	54.6278	55.1871 (38)
Heat transfer coeff	152.8510	152.5440	152.2430	150.8295	150.5651	149.3340	149.3340	149.1060	149.8082	150.5651	151.1001	151.6594 (39)
Average = Sum(39)m / 12 =												150.8283 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2608	1.2583	1.2558	1.2442	1.2420	1.2318	1.2318	1.2299	1.2357	1.2420	1.2464	1.2510 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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Calculation Type: New Build (As Built)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8679 (42)
Average daily hot water use (litres/day)												102.3137 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)
Energy content	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)	Total = Sum(45)m =											1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0352	21.8959	22.5946	19.6985	18.9012	16.3103	15.1139	17.3434	17.5506	20.4535	22.3266	24.2452 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	21.0813	19.0206	21.0113	20.2714	20.8847	20.1372	20.7626	20.8418	20.2098	20.9499	20.3467	21.0586 (61)
Total heat required for water heating calculated for each month	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (64)
	Total per year (kWh/year) = Sum(64)m =											1856.3683 (64)
Heat gains from water heating, kWh/month	60.7649	53.2911	55.3376	48.7329	47.1189	41.1888	38.6931	43.6550	43.9562	50.5760	54.5772	59.0082 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.4245	58.1095	47.2578	35.7772	26.7439	22.5783	24.3967	31.7117	42.5634	54.0440	63.0773	67.2429 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	428.0685	432.5105	421.3168	397.4867	367.4054	339.1333	320.2458	315.8038	326.9975	350.8276	380.9089	409.1810 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Water heating gains (Table 5)	81.6733	79.3022	74.3784	67.6846	63.3318	57.2067	52.0069	58.6761	61.0503	67.9785	75.8017	79.3121 (72)
Total internal gains	690.6008	685.3567	658.3875	616.3830	572.9156	534.3528	512.0838	521.6261	546.0456	588.2846	635.2224	671.1705 (73)

6. Solar gains

[Jan]	Area m2					Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W
Northeast	2.1700					11.2829	0.6200	0.7000	0.7700			7.3639 (75)
Southeast	5.2700					36.7938	0.6200	0.7000	0.7700			58.3188 (77)
Southwest	2.1100					36.7938	0.6200	0.7000	0.7700			23.3497 (79)
Northwest	7.0100					11.2829	0.6200	0.7000	0.7700			23.7883 (81)
Southeast	3.1500					36.7938	0.6200	0.7000	0.7700			34.8585 (77)
Southeast	1.5200					39.9751	0.6300	0.7000	1.0000			24.1165 (82)
Solar gains	171.7956	306.2310	453.4628	616.9200	739.2946	754.6671	718.9960	624.8780	509.8068	347.9032	208.2884	145.3709 (83)
Total gains	862.3964	991.5877	1111.8504	1233.3030	1312.2102	1289.0199	1231.0798	1146.5041	1055.8525	936.1878	843.5108	816.5414 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	29.7388	29.7987	29.8576	30.1374	30.1903	30.4392	30.4392	30.4857	30.3429	30.1903	30.0834	29.9725
alpha	2.9826	2.9866	2.9905	3.0092	3.0127	3.0293	3.0293	3.0324	3.0229	3.0127	3.0056	2.9982
util living area	0.9736	0.9592	0.9317	0.8742	0.7746	0.6309	0.4934	0.5403	0.7434	0.9022	0.9604	0.9773 (86)
MIT	18.9786	19.2230	19.6156	20.1145	20.5447	20.8304	20.9409	20.9210	20.7044	20.1444	19.4714	18.9295 (87)
Th 2	19.8716	19.8736	19.8756	19.8848	19.8866	19.8946	19.8946	19.8961	19.8915	19.8866	19.8831	19.8794 (88)
util rest of house	0.9686	0.9514	0.9184	0.8484	0.7268	0.5507	0.3844	0.4310	0.6735	0.8767	0.9515	0.9730 (89)
MIT 2	17.2016	17.5548	18.1185	18.8249	19.4021	19.7538	19.8618	19.8487	19.6192	18.8832	17.9241	17.1352 (90)
Living area fraction	17.4977	17.8328	18.3679	19.0397	19.5925	19.9332	20.0416	20.0274	fLA = Living area / (4) =	19.8000	19.0933	18.1819
MIT	17.4977	17.8328	18.3679	19.0397	19.5925	19.9332	20.0416	20.0274	19.8000	19.0933	18.1819	17.4341 (92)
Temperature adjustment	17.3477	17.6828	18.2179	18.8897	19.4425	19.7832	19.8916	19.8774	19.6500	18.9433	18.0319	-0.1500
adjusted MIT	17.3477	17.6828	18.2179	18.8897	19.4425	19.7832	19.8916	19.8774	19.6500	18.9433	18.0319	17.2841 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9517	0.9301	0.8920	0.8200	0.7048	0.5418	0.3840	0.4290	0.6558	0.8483	0.9304	0.9577 (94)

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Useful gains	820.7597	922.2367	991.7872	1011.3379	924.7972	698.3738	472.7893	491.8096	692.4802	794.2084	784.7706	782.0125 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W												
Month fracti	1994.3529	1949.9318	1783.9709	1506.7489	1165.7439	774.0270	491.5520	518.5013	831.4412	1256.2116	1651.8145	1984.3330 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating	873.1533	690.6111	589.3847	356.6959	179.2644	0.0000	0.0000	0.0000	0.0000	343.7304	624.2716	894.5264 (98)
Space heating per m2											(98) / (4) =	37.5455 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.0000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												5057.3753 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	873.1533	690.6111	589.3847	356.6959	179.2644	0.0000	0.0000	0.0000	0.0000	343.7304	624.2716	894.5264 (98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)	970.1704	767.3456	654.8719	396.3288	199.1826	0.0000	0.0000	0.0000	0.0000	381.9226	693.6351	993.9182 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (64)
Efficiency of water heater	89.3972	89.3442	89.2340	88.9898	88.4832	86.7000	86.7000	86.7000	86.7000	88.9372	89.2754	86.7000 (216)
Fuel for water heating, kWh/month	210.2776	184.6715	192.3506	170.3509	166.0121	148.6420	140.1636	157.3985	158.2624	176.8736	189.5152	204.3030 (219)
Water heating fuel used												2098.8211 (219)
Annual totals kWh/year												
Space heating fuel - main system												5057.3753 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												75.0000 (231)
Electricity for lighting (calculated in Appendix L)												462.1671 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 1004 * 1.00) =									-650.5895			-650.5895 (233)
Total delivered energy for all uses												7042.7740 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5057.3753	3.4800	175.9967 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2098.8211	3.4800	73.0390 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	462.1671	13.1900	60.9598 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-650.5895	13.1900	-85.8128 (252)
Total energy cost			354.0752 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.8946 (257)
SAP value		87.5201
SAP rating (Section 12)		88 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5057.3753	0.2160	1092.3931 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2098.8211	0.2160	453.3454 (264)
Space and water heating			1545.7384 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	462.1671	0.5190	239.8647 (268)

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Energy saving/generation technologies			
PV Unit	-650.5895	0.5190	-337.6560 (269)
Total kg/year			1486.8722 (272)
CO2 emissions per m2			12.2600 (273)
EI value			88.0141
EI rating			88 (274)
EI band			B

----- Calculation of stars for heating and DHW -----

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
Water heating energy efficiency	$3.48 / 0.8832 = 3.940$, stars = 4
Water heating environmental impact	$0.216 / 0.8832 = 0.2446$, stars = 4

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Calculation Type: New Build (As Built)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

						main heating	secondary heating	other		total	m3 per hour			
Number of chimneys						0	+	0	+	0	=	0 * 40 =	0.0000 (6a)	
Number of open flues						0	+	0	+	0	=	0 * 20 =	0.0000 (6b)	
Number of intermittent fans												4 * 10 =	40.0000 (7a)	
Number of passive vents												0 * 10 =	0.0000 (7b)	
Number of flueless gas fires												0 * 40 =	0.0000 (7c)	
												Air changes per hour		
Infiltration due to chimneys, flues and fans						= (6a)+(6b)+(7a)+(7b)+(7c) =						40.0000 / (5) =		0.1362 (8)
Pressure test												Yes		
Measured/design AP50														4.7300
Infiltration rate														0.3727 (18)
Number of sides sheltered														2 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =		0.3168 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Wind factor	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)	
Adj infilt rate	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)	
	0.3326	0.3088	0.3168	0.3009	0.3009	0.2930	0.2851	0.2772	0.2692	0.2930	0.2772	0.2930	(22b)	
Effective ac	0.5553	0.5477	0.5502	0.5453	0.5453	0.5429	0.5406	0.5384	0.5362	0.5429	0.5384	0.5429	(25)	

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			16.5600	1.3258	21.9545		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Roof Lights (Uw = 1.60)			1.5200	1.5038	2.2857		(27a)
Jet Floor Lo			43.5000	0.1800	7.8300	75.0000	3262.5000 (28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.2500	36.8900	60.0000	8853.6000 (29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.3000	1.1370	9.0000	34.1100 (29a)
Wall to Void	14.5300		14.5300	0.1600	2.3248	9.0000	130.7700 (29a)
Plane	22.8000		22.8000	0.1300	2.9640	9.0000	205.2000 (30)
Sloping	13.9200	1.5200	12.4000	0.1600	1.9840	9.0000	111.6000 (30)
Bay	0.9700		0.9700	0.1300	0.1261	9.0000	8.7300 (30)
Ceiling to Void	7.3700		7.3700	0.2600	1.9162	9.0000	66.3300 (30)
Dormer Roof	2.3300		2.3300	0.3000	0.6990	9.0000	20.9700 (30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.2045		(33)
GF			64.1200			9.0000	577.0800 (32c)
FF			70.8400			9.0000	637.5600 (32c)
2F			60.0600			9.0000	540.5400 (32c)
Internal Floor 1			26.6000			18.0000	478.8000 (32d)
Internal Floor 2			26.6000			18.0000	478.8000 (32d)
Internal Floor 1			26.6000			18.0000	478.8000 (32e)
Internal Floor 2			26.6000			18.0000	478.8000 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16364.1900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2678 (36)
Total fabric heat loss					(33) + (36) =		96.4723 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 53.8344	Feb 53.0957	Mar 53.3359	Apr 52.8617	May 52.8617	Jun 52.6337	Jul 52.4118	Aug 52.1960	Sep 51.9862	Oct 52.6337	Nov 52.1960	Dec 52.6337 (38)
Heat transfer coeff	150.3067	149.5680	149.8082	149.3340	149.3340	149.1060	148.8841	148.6683	148.4585	149.1060	148.6683	149.1060 (39)
Average = Sum(39)m / 12 =												149.1957 (39)
HLP	Jan 1.2398	Feb 1.2338	Mar 1.2357	Apr 1.2318	May 1.2318	Jun 1.2299	Jul 1.2281	Aug 1.2263	Sep 1.2246	Oct 1.2299	Nov 1.2263	Dec 1.2299 (40)
HLP (average)												1.2307 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8679 (42)
Average daily hot water use (litres/day)												102.3137 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)
Energy content	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)	Total = Sum(45)m =											1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0352	21.8959	22.5946	19.6985	18.9012	16.3103	15.1139	17.3434	17.5506	20.4535	22.3266	24.2452 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	21.0813	19.0206	21.0113	20.2714	20.8847	20.1372	20.7626	20.8418	20.2098	20.9499	20.3467	21.0586 (61)
Total heat required for water heating calculated for each month	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (64)
	Total per year (kWh/year) = Sum(64)m =											1856.3683 (64)
Heat gains from water heating, kWh/month	60.7649	53.2911	55.3376	48.7329	47.1189	41.1888	38.6931	43.6550	43.9562	50.5760	54.5772	59.0082 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.4245	58.1095	47.2578	35.7772	26.7439	22.5783	24.3967	31.7117	42.5634	54.0440	63.0773	67.2429 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	428.0685	432.5105	421.3168	397.4867	367.4054	339.1333	320.2458	315.8038	326.9975	350.8276	380.9089	409.1810 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Water heating gains (Table 5)	81.6733	79.3022	74.3784	67.6846	63.3318	57.2067	52.0069	58.6761	61.0503	67.9785	75.8017	79.3121 (72)
Total internal gains	690.6008	685.3567	658.3875	616.3830	572.9156	534.3528	512.0838	521.6261	546.0456	588.2846	635.2224	671.1705 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast					2.1700	14.6176	0.6200	0.7000	0.7700		9.5403 (75)	
Southeast					5.2700	45.1778	0.6200	0.7000	0.7700		71.6076 (77)	
Southwest					2.1100	45.1778	0.6200	0.7000	0.7700		28.6702 (79)	
Northwest					7.0100	14.6176	0.6200	0.7000	0.7700		30.8190 (81)	
Southeast					3.1500	45.1778	0.6200	0.7000	0.7700		42.8015 (77)	
Southeast					1.5200	50.2544	0.6300	0.7000	1.0000		30.3179 (82)	
Solar gains	213.7564	325.2246	488.0516	672.0283	768.0979	852.6291	805.6153	715.6886	580.9519	399.3653	258.5118	177.6882 (83)
Total gains	904.3572	1010.5813	1146.4392	1288.4112	1341.0135	1386.9819	1317.6991	1237.3147	1126.9975	987.6499	893.7342	848.8587 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.2422	30.3916	30.3429	30.4392	30.4392	30.4857	30.5312	30.5755	30.6187	30.4857	30.5755	30.4857
alpha	3.0161	3.0261	3.0229	3.0293	3.0293	3.0324	3.0354	3.0384	3.0412	3.0324	3.0384	3.0324
util living area	0.9672	0.9540	0.9199	0.8475	0.7308	0.5504	0.4194	0.4425	0.6786	0.8703	0.9470	0.9715 (86)
MIT	19.1659	19.3543	19.7609	20.2560	20.6558	20.8970	20.9666	20.9615	20.7968	20.3194	19.6879	19.1420 (87)
Th 2	19.8883	19.8931	19.8915	19.8946	19.8946	19.8961	19.8976	19.8990	19.9004	19.8961	19.8990	19.8961 (88)
util rest of house	0.9608	0.9453	0.9042	0.8169	0.6748	0.4628	0.3095	0.3281	0.5978	0.8365	0.9349	0.9659 (89)
MIT 2	17.4824	17.7557	18.3345	19.0238	19.5472	19.8205	19.8824	19.8812	19.7288	19.1279	18.2441	17.4534 (90)
Living area fraction	fLA = Living area / (4) = 0.1666 (91)											
MIT	17.7629	18.0221	18.5722	19.2291	19.7319	19.9998	20.0630	20.0612	19.9068	19.3264	18.4847	17.7347 (92)
Temperature adjustment	-0.1500											
adjusted MIT	17.6129	17.8721	18.4222	19.0791	19.5819	19.8498	19.9130	19.9112	19.7568	19.1764	18.3347	17.5847 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9420	0.9230	0.8771	0.7896	0.6568	0.4589	0.3111	0.3294	0.5860	0.8087	0.9110	0.9485 (94)

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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Useful gains	851.8637	932.7996	1005.5654	1017.3899	880.7772	636.4310	409.9200	407.5758	660.3731	798.7103	814.2348	805.1316 (95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W												
Month fracti	1910.8338	1880.3826	1711.1374	1430.4917	1057.5707	678.4070	418.8157	417.9362	750.7186	1159.5134	1551.3076	1876.4604 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating	787.8738	636.7758	524.9456	297.4333	131.5344	0.0000	0.0000	0.0000	0.0000	268.4375	530.6924	797.0686 (98)
Space heating per m2												3974.7615 (98)
											(98) / (4) =	32.7869 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.0000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4416.4016 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	787.8738	636.7758	524.9456	297.4333	131.5344	0.0000	0.0000	0.0000	0.0000	268.4375	530.6924	797.0686 (98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)	875.4153	707.5287	583.2729	330.4815	146.1493	0.0000	0.0000	0.0000	0.0000	298.2639	589.6582	885.6318 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (64)
Efficiency of water heater	89.3449	89.3005	89.1638	88.8582	88.2283	86.7000	86.7000	86.7000	86.7000	88.7518	89.1794	86.7000 (216)
Fuel for water heating, kWh/month	210.4007	184.7618	192.5021	170.6033	166.4917	148.6420	140.1636	157.3985	158.2624	177.2430	189.7192	204.4333 (219)
Water heating fuel used												2100.6217 (219)
Annual totals kWh/year												
Space heating fuel - main system												4416.4016 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												75.0000 (231)
Electricity for lighting (calculated in Appendix L)												462.1671 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 1122 * 1.00) =										-727.0046		-727.0046 (233)
Total delivered energy for all uses												6327.1859 (238)

10a. Fuel costs - using BEDF prices (435)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4416.4016	3.9400	174.0062 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2100.6217	3.9400	82.7645 (247)
Pumps and fans for heating	75.0000	16.5500	12.4125 (249)
Energy for lighting	462.1671	16.5500	76.4887 (250)
Additional standing charges			87.0000 (251)
Energy saving/generation technologies			
PV Unit	-727.0046	16.5500	-120.3193 (252)
Total energy cost			312.3526 (255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4416.4016	0.2160	953.9428 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2100.6217	0.2160	453.7343 (264)
Space and water heating			1407.6770 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	462.1671	0.5190	239.8647 (268)
Energy saving/generation technologies			
PV Unit	-727.0046	0.5190	-377.3154 (269)
Total kg/year			1309.1514 (272)

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

Energy Primary energy factor Primary energy

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	kWh/year	kg CO2/kWh	kWh/year
Space heating - main system 1	4416.4016	1.2200	5388.0100 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2100.6217	1.2200	2562.7585 (264)
Space and water heating			7950.7685 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	462.1671	3.0700	1418.8530 (268)
Energy saving/generation technologies			
PV Unit	-727.0046	3.0700	-2231.9040 (269)
Primary energy kWh/year			7367.9675 (272)
Primary energy kWh/m2/year			60.7768 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 88

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 33	-200 kg (15.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£33 1.65 kg/m²	B 89	B 90
Total Savings	£33 1.65 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 435 TEST (16 Nov 2018)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£89	£97	-£8
Mains gas	£344	£303	£41
Space heating	£273	£273	£0
Water heating	£83	£50	£33
Lighting	£76	£76	£0
Generated (PV)	-£120	-£120	£0
Total cost of fuels	£313	£280	£33
Total cost of uses	£312	£279	£33
Delivered energy	52 kWh/m²	44 kWh/m²	8 kWh/m²
Carbon dioxide emissions	1.3 tonnes	1.1 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	9 kg/m²	2 kg/m²
Primary energy	61 kWh/m²	52 kWh/m²	9 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.7300
Infiltration rate					0.3727 (18)
Number of sides sheltered					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3168 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4039	0.3960	0.3880	0.3484	0.3405	0.3009	0.3009	0.2930	0.3168	0.3405	0.3564	0.3722 (22b)
Effective ac	0.5816	0.5784	0.5753	0.5607	0.5580	0.5453	0.5453	0.5429	0.5502	0.5580	0.5635	0.5693 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			16.5600	1.3258	21.9545		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Roof Lights (Uw = 1.60)			1.5200	1.5038	2.2857		(27a)
Jet Floor Lo			43.5000	0.1800	7.8300	75.0000	3262.5000 (28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.2500	36.8900	60.0000	8853.6000 (29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.3000	1.1370	9.0000	34.1100 (29a)
Wall to Void	14.5300		14.5300	0.1600	2.3248	9.0000	130.7700 (29a)
Plane	22.8000		22.8000	0.1300	2.9640	9.0000	205.2000 (30)
Sloping	13.9200	1.5200	12.4000	0.1600	1.9840	9.0000	111.6000 (30)
Bay	0.9700		0.9700	0.1300	0.1261	9.0000	8.7300 (30)
Ceiling to Void	7.3700		7.3700	0.2600	1.9162	9.0000	66.3300 (30)
Dormer Roof	2.3300		2.3300	0.3000	0.6990	9.0000	20.9700 (30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.2045		(33)
GF			64.1200			9.0000	577.0800 (32c)
FF			70.8400			9.0000	637.5600 (32c)
2F			60.0600			9.0000	540.5400 (32c)
Internal Floor 1			26.6000			18.0000	478.8000 (32d)
Internal Floor 2			26.6000			18.0000	478.8000 (32d)
Internal Floor 1			26.6000			18.0000	478.8000 (32e)
Internal Floor 2			26.6000			18.0000	478.8000 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16364.1900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2678 (36)
Total fabric heat loss					(33) + (36) =		96.4723 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	56.3786	56.0716	55.7707	54.3572	54.0928	52.8617	52.8617	52.6337	53.3359	54.0928	54.6278	55.1871 (38)
Heat transfer coeff	152.8510	152.5440	152.2430	150.8295	150.5651	149.3340	149.3340	149.1060	149.8082	150.5651	151.1001	151.6594 (39)
Average = Sum(39)m / 12 =												150.8283 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2608	1.2583	1.2558	1.2442	1.2420	1.2318	1.2318	1.2299	1.2357	1.2420	1.2464	1.2510 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8679 (42)
Average daily hot water use (litres/day)												102.3137 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)
Energy content	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)												Total = Sum(45)m = 1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0352	21.8959	22.5946	19.6985	18.9012	16.3103	15.1139	17.3434	17.5506	20.4535	22.3266	24.2452 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	21.0813	19.0206	21.0113	20.2714	20.8847	20.1372	20.7626	20.8418	20.2098	20.9499	20.3467	21.0586 (61)
Total heat required for water heating calculated for each month	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1266 (H8)
Utilisation factor												0.5884 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												102.3137 (H14)
Volume ratio Veff/V												0.7330 (H15)
Solar storage volume factor												0.9379 (H16)
Solar input												-879.9846 (H17)
Solar input	-25.5178	-42.5819	-72.5218	-97.1935	-120.0744	-118.0522	-116.4921	-101.7798	-79.7140	-54.4353	-30.2678	-21.3540 (63)
Output from w/h	162.4645	122.4114	99.1203	54.4014	26.8184	10.8204	5.0297	34.6848	57.4995	102.8712	138.9228	161.3393 (64)
Heat gains from water heating, kWh/month	60.7649	53.2911	55.3376	48.7329	47.1189	41.1888	38.6931	43.6550	43.9562	50.5760	54.5772	59.0082 (65)
Solar input (sum of months) = Sum(63)m = -879.9846 (63)												
Total per year (kWh/year) = Sum(64)m = 976.3837 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.4245	58.1095	47.2578	35.7772	26.7439	22.5783	24.3967	31.7117	42.5634	54.0440	63.0773	67.2429 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	428.0685	432.5105	421.3168	397.4867	367.4054	339.1333	320.2458	315.8038	326.9975	350.8276	380.9089	409.1810 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Water heating gains (Table 5)	81.6733	79.3022	74.3784	67.6846	63.3318	57.2067	52.0069	58.6761	61.0503	67.9785	75.8017	79.3121 (72)
Total internal gains	690.6008	685.3567	658.3875	616.3830	572.9156	534.3528	512.0838	521.6261	546.0456	588.2846	635.2224	671.1705 (73)

6. Solar gains

[Jan]						Area	Solar flux		g	FF	Access		Gains
						m2	Table 6a		Specific data	Specific data	factor		
							W/m2		or Table 6b	or Table 6c	Table 6d	W	
Northeast						2.1700	11.2829		0.6200	0.7000	0.7700	7.3639 (75)	
Southeast						5.2700	36.7938		0.6200	0.7000	0.7700	58.3188 (77)	
Southwest						2.1100	36.7938		0.6200	0.7000	0.7700	23.3497 (79)	
Northwest						7.0100	11.2829		0.6200	0.7000	0.7700	23.7883 (81)	
Southeast						3.1500	36.7938		0.6200	0.7000	0.7700	34.8585 (77)	
Southeast						1.5200	39.9751		0.6300	0.7000	1.0000	24.1165 (82)	

Solar gains	171.7956	306.2310	453.4628	616.9200	739.2946	754.6671	718.9960	624.8780	509.8068	347.9032	208.2884	145.3709 (83)	
Total gains	862.3964	991.5877	1111.8504	1233.3030	1312.2102	1289.0199	1231.0798	1146.5041	1055.8525	936.1878	843.5108	816.5414 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	29.7388	29.7987	29.8576	30.1374	30.1903	30.4392	30.4392	30.4857	30.3429	30.1903	30.0834	29.9725
alpha	2.9826	2.9866	2.9905	3.0092	3.0127	3.0293	3.0293	3.0324	3.0229	3.0127	3.0056	2.9982
util living area	0.9736	0.9592	0.9317	0.8742	0.7746	0.6309	0.4934	0.5403	0.7434	0.9022	0.9604	0.9773 (86)

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Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	18.9786	19.2230	19.6156	20.1145	20.5447	20.8304	20.9409	20.9210	20.7044	20.1444	19.4714	18.9295 (87)
Th 2	19.8716	19.8736	19.8756	19.8848	19.8866	19.8946	19.8946	19.8961	19.8915	19.8866	19.8831	19.8794 (88)
util rest of house												
	0.9686	0.9514	0.9184	0.8484	0.7268	0.5507	0.3844	0.4310	0.6735	0.8767	0.9515	0.9730 (89)
MIT 2	17.2016	17.5548	18.1185	18.8249	19.4021	19.7538	19.8618	19.8487	19.6192	18.8832	17.9241	17.1352 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	17.4977	17.8328	18.3679	19.0397	19.5925	19.9332	20.0416	20.0274	19.8000	19.0933	18.1819	17.4341 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3477	17.6828	18.2179	18.8897	19.4425	19.7832	19.8916	19.8774	19.6500	18.9433	18.0319	17.2841 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9517	0.9301	0.8920	0.8200	0.7048	0.5418	0.3840	0.4290	0.6558	0.8483	0.9304	0.9577 (94)
Useful gains	820.7597	922.2367	991.7872	1011.3379	924.7972	698.3738	472.7893	491.8096	692.4802	794.2084	784.7706	782.0125 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1994.3529	1949.9318	1783.9709	1506.7489	1165.7439	774.0270	491.5520	518.5013	831.4412	1256.2116	1651.8145	1984.3330 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	873.1533	690.6111	589.3847	356.6959	179.2644	0.0000	0.0000	0.0000	0.0000	343.7304	624.2716	894.5264 (98)
Space heating												4551.6378 (98)
Space heating per m2										(98) / (4) =		37.5455 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5057.3753 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	873.1533	690.6111	589.3847	356.6959	179.2644	0.0000	0.0000	0.0000	0.0000	343.7304	624.2716	894.5264 (98)	
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)	
Space heating fuel (main heating system)	970.1704	767.3456	654.8719	396.3288	199.1826	0.0000	0.0000	0.0000	0.0000	381.9226	693.6351	993.9182 (211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	162.4645	122.4114	99.1203	54.4014	26.8184	10.8204	5.0297	34.6848	57.4995	102.8712	138.9228	161.3393 (64)	
Efficiency of water heater (217)m	89.4658	89.4872	89.5095	89.5490	89.5564	86.7000	86.7000	86.7000	86.7000	89.2178	89.3807	86.7000 (216)	
Fuel for water heating, kWh/month	181.5940	136.7922	110.7371	60.7505	29.9458	12.4803	5.8013	40.0055	66.3201	115.3034	155.4281	180.3085 (219)	
Water heating fuel used												1095.4668 (219)	
Annual totals kWh/year													
Space heating fuel - main system												5057.3753 (211)	
Space heating fuel - secondary												0.0000 (215)	
Electricity for pumps and fans:													
central heating pump												30.0000 (230c)	
main heating flue fan												45.0000 (230e)	
pump for solar water heating												50.0000 (230g)	
Total electricity for the above, kWh/year												125.0000 (231)	
Electricity for lighting (calculated in Appendix L)												462.1671 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1004 * 1.00) =									-650.5895			-650.5895 (233)	
Total delivered energy for all uses												6089.4197 (238)	

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5057.3753	3.4800	175.9967 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	1095.4668	3.4800	38.1222 (247)	
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)	
Pump for solar water heating	50.0000	13.1900	6.5950 (249)	
Energy for lighting	462.1671	13.1900	60.9598 (250)	
Additional standing charges			120.0000 (251)	
Energy saving/generation technologies				
PV Unit	-650.5895	13.1900	-85.8128 (252)	
Total energy cost			325.7535 (255)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8231 (257)
SAP value		88.5184
SAP rating (Section 12)		89 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5057.3753	0.2160	1092.3931	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1095.4668	0.2160	236.6208	(264)
Space and water heating			1329.0139	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	462.1671	0.5190	239.8647	(268)
Energy saving/generation technologies				
PV Unit	-650.5895	0.5190	-337.6560	(269)
Total kg/year			1296.0977	(272)
CO2 emissions per m2			10.6900	(273)
EI value			89.5520	
EI rating			90	(274)
EI band			B	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	43.5000 (1b)	x 2.3100 (2b)	= 100.4850 (1b) - (3b)
First floor	42.5500 (1c)	x 2.5500 (2c)	= 108.5025 (1c) - (3c)
Second floor	35.1800 (1d)	x 2.4100 (2d)	= 84.7838 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 293.7713 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.7300
Infiltration rate					0.3727 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3168 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate	0.3326	0.3088	0.3168	0.3009	0.3009	0.2930	0.2851	0.2772	0.2692	0.2930	0.2772	0.2930 (22b)
Effective ac	0.5553	0.5477	0.5502	0.5453	0.5453	0.5429	0.5406	0.5384	0.5362	0.5429	0.5384	0.5429 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			2.1300	0.9000	1.9170		(26)
Window (Uw = 1.40)			16.5600	1.3258	21.9545		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Roof Lights (Uw = 1.60)			1.5200	1.5038	2.2857		(27a)
Jet Floor Lo			43.5000	0.1800	7.8300	75.0000	3262.5000 (28a)
100mm Knauf Supafil	167.4800	19.9200	147.5600	0.2500	36.8900	60.0000	8853.6000 (29a)
Dormer Cheek	5.7100	1.9200	3.7900	0.3000	1.1370	9.0000	34.1100 (29a)
Wall to Void	14.5300		14.5300	0.1600	2.3248	9.0000	130.7700 (29a)
Plane	22.8000		22.8000	0.1300	2.9640	9.0000	205.2000 (30)
Sloping	13.9200	1.5200	12.4000	0.1600	1.9840	9.0000	111.6000 (30)
Bay	0.9700		0.9700	0.1300	0.1261	9.0000	8.7300 (30)
Ceiling to Void	7.3700		7.3700	0.2600	1.9162	9.0000	66.3300 (30)
Dormer Roof	2.3300		2.3300	0.3000	0.6990	9.0000	20.9700 (30)
Total net area of external elements Aum(A, m ²)			278.6100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.2045		(33)
GF			64.1200			9.0000	577.0800 (32c)
FF			70.8400			9.0000	637.5600 (32c)
2F			60.0600			9.0000	540.5400 (32c)
Internal Floor 1			26.6000			18.0000	478.8000 (32d)
Internal Floor 2			26.6000			18.0000	478.8000 (32d)
Internal Floor 1			26.6000			18.0000	478.8000 (32e)
Internal Floor 2			26.6000			18.0000	478.8000 (32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16364.1900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							134.9847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2678 (36)
Total fabric heat loss						(33) + (36) =	96.4723 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	53.8344	53.0957	53.3359	52.8617	52.8617	52.6337	52.4118	52.1960	51.9862	52.6337	52.1960	52.6337 (38)
Heat transfer coeff	150.3067	149.5680	149.8082	149.3340	149.3340	149.1060	148.8841	148.6683	148.4585	149.1060	148.6683	149.1060 (39)
Average = Sum(39)m / 12 =												149.1957 (39)
HLP	1.2398	1.2338	1.2357	1.2318	1.2318	1.2299	1.2281	1.2263	1.2246	1.2299	1.2263	1.2299 (40)
HLP (average)												1.2307 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8679 (42)
Average daily hot water use (litres/day)												102.3137 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.5450	108.4525	104.3599	100.2674	96.1748	92.0823	92.0823	96.1748	100.2674	104.3599	108.4525	112.5450 (44)
Energy content	166.9010	145.9727	150.6308	131.3236	126.0081	108.7354	100.7593	115.6228	117.0037	136.3565	148.8438	161.6347 (45)
Energy content (annual)	Total = Sum(45)m =											1609.7924 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0352	21.8959	22.5946	19.6985	18.9012	16.3103	15.1139	17.3434	17.5506	20.4535	22.3266	24.2452 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	21.0813	19.0206	21.0113	20.2714	20.8847	20.1372	20.7626	20.8418	20.2098	20.9499	20.3467	21.0586 (61)
Total heat required for water heating calculated for each month	187.9823	164.9933	171.6421	151.5949	146.8928	128.8726	121.5219	136.4645	137.2135	157.3064	169.1905	182.6934 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2608 (H8)
Utilisation factor												0.5476 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												102.3137 (H14)
Volume ratio Veff/V												0.7330 (H15)
Solar storage volume factor												0.9379 (H16)
Solar input												-916.5474 (H17)
Solar input	-29.9000	-42.5159	-73.0746	-98.5945	-115.8052	-123.6983	-121.0969	-108.3854	-84.8583	-58.6681	-35.3638	-24.5865 (63)
	Solar input (sum of months) = Sum(63)m =											-916.5474 (63)
Output from w/h	158.0823	122.4774	98.5675	53.0004	31.0875	5.1744	0.4250	28.0792	52.3553	98.6384	133.8267	158.1069 (64)
	Total per year (kWh/year) = Sum(64)m =											939.8209 (64)
Heat gains from water heating, kWh/month	60.7649	53.2911	55.3376	48.7329	47.1189	41.1888	38.6931	43.6550	43.9562	50.5760	54.5772	59.0082 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766	172.0766 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.4245	58.1095	47.2578	35.7772	26.7439	22.5783	24.3967	31.7117	42.5634	54.0440	63.0773	67.2429 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	428.0685	432.5105	421.3168	397.4867	367.4054	339.1333	320.2458	315.8038	326.9975	350.8276	380.9089	409.1810 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756	55.0756 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178	-114.7178 (71)
Water heating gains (Table 5)	81.6733	79.3022	74.3784	67.6846	63.3318	57.2067	52.0069	58.6761	61.0503	67.9785	75.8017	79.3121 (72)
Total internal gains	690.6008	685.3567	658.3875	616.3830	572.9156	534.3528	512.0838	521.6261	546.0456	588.2846	635.2224	671.1705 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				2.1700	14.6176		0.6200		0.7000		0.7700		9.5403 (75)
Southeast				5.2700	45.1778		0.6200		0.7000		0.7700		71.6076 (77)
Southwest				2.1100	45.1778		0.6200		0.7000		0.7700		28.6702 (79)
Northwest				7.0100	14.6176		0.6200		0.7000		0.7700		30.8190 (81)
Southeast				3.1500	45.1778		0.6200		0.7000		0.7700		42.8015 (77)
Southeast				1.5200	50.2544		0.6300		0.7000		1.0000		30.3179 (82)
Solar gains	213.7564	325.2246	488.0516	672.0283	768.0979	852.6291	805.6153	715.6886	580.9519	399.3653	258.5118	177.6882	(83)
Total gains	904.3572	1010.5813	1146.4392	1288.4112	1341.0135	1386.9819	1317.6991	1237.3147	1126.9975	987.6499	893.7342	848.8587	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.2422	30.3916	30.3429	30.4392	30.4392	30.4857	30.5312	30.5755	30.6187	30.4857	30.5755	30.4857
alpha	3.0161	3.0261	3.0229	3.0293	3.0293	3.0324	3.0354	3.0384	3.0412	3.0324	3.0384	3.0324
util living area												
	0.9672	0.9540	0.9199	0.8475	0.7308	0.5504	0.4194	0.4425	0.6786	0.8703	0.9470	0.9715 (86)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

MIT	19.1659	19.3543	19.7609	20.2560	20.6558	20.8970	20.9666	20.9615	20.7968	20.3194	19.6879	19.1420 (87)
Th 2	19.8883	19.8931	19.8915	19.8946	19.8946	19.8961	19.8976	19.8990	19.9004	19.8961	19.8990	19.8961 (88)
util rest of house												
	0.9608	0.9453	0.9042	0.8169	0.6748	0.4628	0.3095	0.3281	0.5978	0.8365	0.9349	0.9659 (89)
MIT 2	17.4824	17.7557	18.3345	19.0238	19.5472	19.8205	19.8824	19.8812	19.7288	19.1279	18.2441	17.4534 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	17.7629	18.0221	18.5722	19.2291	19.7319	19.9998	20.0630	20.0612	19.9068	19.3264	18.4847	17.7347 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6129	17.8721	18.4222	19.0791	19.5819	19.8498	19.9130	19.9112	19.7568	19.1764	18.3347	17.5847 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9420	0.9230	0.8771	0.7896	0.6568	0.4589	0.3111	0.3294	0.5860	0.8087	0.9110	0.9485 (94)	
Useful gains	851.8637	932.7996	1005.5654	1017.3899	880.7772	636.4310	409.9200	407.5758	660.3731	798.7103	814.2348	805.1316 (95)	
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)	
Heat loss rate W	1910.8338	1880.3826	1711.1374	1430.4917	1057.5707	678.4070	418.8157	417.9362	750.7186	1159.5134	1551.3076	1876.4604 (97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)	
Space heating kWh	787.8738	636.7758	524.9456	297.4333	131.5344	0.0000	0.0000	0.0000	0.0000	268.4375	530.6924	797.0686 (98)	
Space heating												3974.7615 (98)	
Space heating per m2										(98) / (4) =		32.7869 (99)	

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4416.4016 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	787.8738	636.7758	524.9456	297.4333	131.5344	0.0000	0.0000	0.0000	0.0000	268.4375	530.6924	797.0686 (98)	
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)	
Space heating fuel (main heating system)	875.4153	707.5287	583.2729	330.4815	146.1493	0.0000	0.0000	0.0000	0.0000	298.2639	589.6582	885.6318 (211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	158.0823	122.4774	98.5675	53.0004	31.0875	5.1744	0.4250	28.0792	52.3553	98.6384	133.8267	158.1069 (64)	
Efficiency of water heater	89.4312	89.4508	89.4617	89.4849	89.3499	86.7000	86.7000	86.7000	86.7000	89.0888	89.3154	86.7000 (216)	
Fuel for water heating, kWh/month	176.7643	136.9216	110.1784	59.2283	34.7931	5.9681	0.4902	32.3866	60.3867	110.7191	149.8362	176.7811 (219)	
Water heating fuel used												1054.4536 (219)	
Annual totals kWh/year													
Space heating fuel - main system												4416.4016 (211)	
Space heating fuel - secondary												0.0000 (215)	
Electricity for pumps and fans:													
central heating pump												30.0000 (230c)	
main heating flue fan												45.0000 (230e)	
pump for solar water heating												50.0000 (230g)	
Total electricity for the above, kWh/year												125.0000 (231)	
Electricity for lighting (calculated in Appendix L)												462.1671 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1122 * 1.00) =									-727.0046			-727.0046 (233)	
Total delivered energy for all uses												5331.0178 (238)	

10a. Fuel costs - using BEDF prices (435)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4416.4016	3.9400	174.0062 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	1054.4536	3.9400	41.5455 (247)	
Pumps and fans for heating	75.0000	16.5500	12.4125 (249)	
Pump for solar water heating	50.0000	16.5500	8.2750 (249)	
Energy for lighting	462.1671	16.5500	76.4887 (250)	
Additional standing charges			87.0000 (251)	
Energy saving/generation technologies				
PV Unit	-727.0046	16.5500	-120.3193 (252)	
Total energy cost			279.4086 (255)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4416.4016	0.2160	953.9428 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1054.4536	0.2160	227.7620 (264)
Space and water heating			1181.7047 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	462.1671	0.5190	239.8647 (268)
Energy saving/generation technologies			
PV Unit	-727.0046	0.5190	-377.3154 (269)
Total kg/year			1109.1291 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4416.4016	1.2200	5388.0100 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1054.4536	1.2200	1286.4334 (264)
Space and water heating			6674.4435 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	462.1671	3.0700	1418.8530 (268)
Energy saving/generation technologies			
PV Unit	-727.0046	3.0700	-2231.9040 (269)
Primary energy kWh/year			6245.1424 (272)
Primary energy kWh/m2/year			51.5148 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-180				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)			
Property	6, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	88 B	DER	13.57	TER	16.73	
Environmental	88 B	% DER<TER	18.91			
CO ₂ Emissions (t/year)	1.31	DFEE	50.26	TFEE	54.74	
General Requirements Compliance	Pass	% DFEE<TFEE	8.18			
Assessor	Silvio Junges, Tel: 01884 242050				Assessor ID	P637-0001
Client						

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	135.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	387.78 (P1)
Transmission heat loss coefficient	96.47 (37)
Summer heat loss coefficient	484.25 (P2)

Overhangs Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	1.00	1.000	1.000 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	Specific data or Table 6c FF	Shading	Gains W
North East	2.1700	106.0502	0.6200	0.7000	0.9000	80.8995
South East	5.2700	127.3119	0.6200	0.7000	0.9000	235.8600
South West	2.1100	127.3119	0.6200	0.7000	0.9000	94.4335
North West	7.0100	106.0502	0.6200	0.7000	0.9000	261.3391
South East	3.1500	127.3119	0.6200	0.7000	0.9000	140.9789
South East	1.5200	199.8996	0.6300	0.7000	1.0000	120.5970
total:						934.1080

	Jun	Jul	Aug	
Solar gains	1005	934	827	(P3)
Internal gains	531	509	519	
Total summer gains	1536	1443	1345	(P5)
Summer gain/loss ratio	3.17	2.98	2.78	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 135.0)	1.06	1.06	1.06	
Threshold temperature	19.63	21.34	21.13	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			