

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-179				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)			
Property	8, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	87 B	DER	13.60	TER	16.73	
Environmental	88 B	% DER<TER	18.73			
CO ₂ Emissions (t/year)	1.31	DFEE	50.40	TFEE	54.74	
General Requirements Compliance	Pass	% DFEE<TFEE	7.92			
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) 13.60 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)54.7 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)50.4 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:	4.92 (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					4.9200
Infiltration rate					0.3822 (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) =				0.3248 (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	0.4142	0.4060	0.3979	0.3573	0.3492	0.3086	0.3086	0.3005	0.3248	0.3492	0.3654	0.3817 (22b)
Effective ac	0.5858	0.5824	0.5792	0.5638	0.5610	0.5476	0.5476	0.5451	0.5528	0.5610	0.5668	0.5728 (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	56.7869	56.4640	56.1476	54.6611	54.3830	53.0883	53.0883	52.8486	53.5870	54.3830	54.9456	55.5338 (38)
Heat transfer coeff	153.2592	152.9364	152.6199	151.1334	150.8553	149.5606	149.5606	149.3209	150.0593	150.8553	151.4179	152.0061 (39)
Average = Sum(39)m / 12 =												151.1321 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2642	1.2615	1.2589	1.2467	1.2444	1.2337	1.2337	1.2317	1.2378	1.2444	1.2490	1.2539 (40)
HLP (average)												1.2467 (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	29.6596	29.7222	29.7839	30.0768	30.1322	30.3931	30.3931	30.4419	30.2921	30.1322	30.0203	29.9041
alpha	2.9773	2.9815	2.9856	3.0051	3.0088	3.0262	3.0262	3.0295	3.0195	3.0088	3.0014	2.9936
util living area	0.9881	0.9785	0.9586	0.9127	0.8254	0.6909	0.5539	0.6084	0.8101	0.9418	0.9808	0.9902 (86)
MIT	18.7228	18.9811	19.4036	19.9519	20.4411	20.7796	20.9185	20.8899	20.6131	19.9681	19.2438	18.6770 (87)
Th 2	19.8690	19.8711	19.8731	19.8828	19.8847	19.8931	19.8931	19.8947	19.8899	19.8847	19.8810	19.8771 (88)
util rest of house	0.9856	0.9741	0.9498	0.8929	0.7832	0.6116	0.4375	0.4937	0.7481	0.9247	0.9762	0.9882 (89)
MIT 2	16.8303	17.2066	17.8187	18.6052	19.2755	19.7043	19.8463	19.8258	19.5185	18.6433	17.5976	16.7682 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.1457	17.5023	18.0828	18.8296	19.4697	19.8835	20.0249	20.0031	19.7009	18.8641	17.8719	17.0863 (92)
Temperature adjustment												
adjusted MIT	16.9957	17.3523	17.9328	18.6796	19.3197	19.7335	19.8749	19.8531	19.5509	18.7141	17.7219	16.9363 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9757	0.9592	0.9281	0.8650	0.7574	0.5986	0.4354	0.4889	0.7249	0.8992	0.9621	0.9796 (94)

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Useful gains	619.9927	736.2259	833.4804	894.6306	854.7488	668.7008	463.3938	477.5891	635.0088	666.8387	609.5307	582.6048 (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	1945.7299	1904.4076	1744.8753	1478.0173	1149.4780	767.7646	489.8035	515.6233	817.9599	1224.0505	1608.3419	1935.9899 (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	986.3484	785.0181	678.0778	420.0384	219.2786	0.0000	0.0000	0.0000	0.0000	414.5656	719.1440	1006.9185 (98)
Space heating per m2											(98) / (4) =	43.1361 (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												5810.4325 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	986.3484	785.0181	678.0778	420.0384	219.2786	0.0000	0.0000	0.0000	0.0000	414.5656	719.1440	1006.9185 (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)	1095.9427	872.2423	753.4197	466.7093	243.6428	0.0000	0.0000	0.0000	0.0000	460.6284	799.0489	1118.7983 (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	89.4550	89.4090	89.3133	89.1006	88.6465	86.7000	86.7000	86.7000	86.7000	89.0675	89.3523	86.7000 (216)
Fuel for water heating, kWh/month	210.1418	184.5378	192.1797	170.1390	165.7063	148.6420	140.1636	157.3985	158.2624	176.6149	189.3523	204.1792 (219)
Water heating fuel used												2097.3177 (219)
Annual totals kWh/year												
Space heating fuel - main system												5810.4325 (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												7794.3278 (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	5810.4325	0.2160	1255.0534 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2097.3177	0.2160	453.0206 (264)
Space and water heating			1708.0740 (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			1649.2078 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.6000 (273)

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

DER			13.6000 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			29.1686 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			29.1686 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) =					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)

	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 m2										(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	4907-0015-3817-179				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)			
Property	8, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	87 B	DER	13.60	TER	16.73	
Environmental	88 B	% DER<TER	18.73			
CO ₂ Emissions (t/year)	1.31	DFEE	50.40	TFEE	54.74	
General Requirements Compliance	Pass	% DFEE<TFEE	7.92			
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					4.9200
Infiltration rate					0.3822 (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) =				0.3248 (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	0.4142	0.4060	0.3979	0.3573	0.3492	0.3086	0.3086	0.3005	0.3248	0.3492	0.3654	0.3817 (22b)
Effective ac	0.5858	0.5824	0.5792	0.5638	0.5610	0.5476	0.5476	0.5451	0.5528	0.5610	0.5668	0.5728 (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 $\text{kJ/m}^2\text{K}$ 131.0351 (35)
 Thermal bridges (Sum($L \times \text{Psi}$) calculated using Appendix K) 10.2678 (36)
 Total fabric heat loss (33) + (36) = 96.4723 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)\text{m} \times (5)$												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	56.7869	56.4640	56.1476	54.6611	54.3830	53.0883	53.0883	52.8486	53.5870	54.3830	54.9456	55.5338 (38)
Average = Sum(39)m / 12 =	153.2592	152.9364	152.6199	151.1334	150.8553	149.5606	149.5606	149.3209	150.0593	150.8553	151.4179	152.0061 (39)
	151.1321 (39)											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2642	1.2615	1.2589	1.2467	1.2444	1.2337	1.2337	1.2317	1.2378	1.2444	1.2490	1.2539 (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)
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	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 m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	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)													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	28.7918	28.8526	28.9124	29.1968	29.2506	29.5038	29.5038	29.5512	29.4058	29.2506	29.1419	29.0292	
alpha	2.9195	2.9235	2.9275	2.9465	2.9500	2.9669	2.9669	2.9701	2.9604	2.9500	2.9428	2.9353	
util living area	0.9890	0.9796	0.9602	0.9153	0.8299	0.6978	0.5621	0.6183	0.8172	0.9449	0.9822	0.9910 (86)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

MIT	18.6354	18.9004	19.3346	19.8993	20.4059	20.7609	20.9097	20.8779	20.5839	19.9142	19.1694	18.5892 (87)
Th 2	19.8690	19.8711	19.8731	19.8828	19.8847	19.8931	19.8931	19.8947	19.8899	19.8847	19.8810	19.8771 (88)
util rest of house												
	0.9867	0.9755	0.9518	0.8962	0.7888	0.6196	0.4457	0.5040	0.7572	0.9288	0.9779	0.9891 (89)
MIT 2	17.7111	17.9755	18.4061	18.9630	19.4393	19.7514	19.8569	19.8414	19.6139	18.9884	18.2518	17.6708 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	17.8651	18.1296	18.5608	19.1190	19.6004	19.9196	20.0323	20.0141	19.7755	19.1426	18.4047	17.8239 (92)
Temperature adjustment												0.0000
adjusted MIT	17.8651	18.1296	18.5608	19.1190	19.6004	19.9196	20.0323	20.0141	19.7755	19.1426	18.4047	17.8239 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9668	0.9389	0.8800	0.7765	0.6217	0.4615	0.5177	0.7498	0.9146	0.9700	0.9843 (94)	
Useful gains	587.1358	707.1371	810.9618	882.0688	852.7646	677.0132	479.1308	490.8617	634.6686	648.9721	580.7049	549.8393 (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													
	2078.9753	2023.2903	1840.7174	1544.4375	1191.8151	795.6061	513.3411	539.6675	851.6660	1288.6996	1711.7336	2070.9103 (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													
	1109.9286	884.4550	766.1382	476.9054	252.2535	0.0000	0.0000	0.0000	0.0000	475.9572	814.3407	1131.6768 (98)	
Space heating												5911.6554 (98)	
Space heating per m2												48.7640 (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	1405.8699	1106.7487	1134.8387	0.0000	0.0000	0.0000	0.0000 (100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7380	0.8066	0.7708	0.0000	0.0000	0.0000	0.0000 (101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1037.5657	892.7470	874.7824	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	238.9741	309.1151	247.5592	0.0000	0.0000	0.0000	0.0000 (104)	
Space cooling												795.6484 (104)	
Cooled fraction												1.0000 (105)	
Intermittency factor (Table 10b)									fC = cooled area / (4) =				
	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	59.7435	77.2788	61.8898	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												198.9121 (107)	
Space cooling per m2												1.6408 (108)	
Energy for space heating												48.7640 (99)	
Energy for space cooling												1.6408 (108)	
Total												50.4047 (109)	
Dwelling Fabric Energy Efficiency (DFEE)												50.4 (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)

	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)

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)
	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	4907-0015-3817-179				Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)			
Property	8, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE					
SAP Rating	87 B	DER	13.60	TER	16.73	
Environmental	88 B	% DER<TER	18.73			
CO ₂ Emissions (t/year)	1.31	DFEE	50.40	TFEE	54.74	
General Requirements Compliance	Pass	% DFEE<TFEE	7.92			
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					4.9200
Infiltration rate					0.3822 (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) =				0.3248 (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
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
Adj infilt rate	0.3411	0.3167	0.3248	0.3086	0.3086	0.3005	0.2924	0.2842	0.2761	0.3005	0.2842	0.3005
Effective ac	0.5582	0.5502	0.5528	0.5476	0.5476	0.5451	0.5427	0.5404	0.5381	0.5451	0.5404	0.5451

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	54.1113	53.3345	53.5870	53.0883	53.0883	52.8486	52.6152	52.3882	52.1677	52.8486	52.3882	52.8486 (38)
Average = Sum(39)m / 12 =	150.5836	149.8068	150.0593	149.5606	149.5606	149.3209	149.0875	148.8606	148.6400	149.3209	148.8606	149.3209 (39)
												149.4152 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2421	1.2357	1.2378	1.2337	1.2337	1.2317	1.2298	1.2279	1.2261	1.2317	1.2279	1.2317 (40)
Days in month												1.2325 (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	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)
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												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)
												1856 (64)

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	30.1866	30.3431	30.2921	30.3931	30.3931	30.4419	30.4895	30.5360	30.5813	30.4419	30.5360	30.4419
alpha	3.0124	3.0229	3.0195	3.0262	3.0262	3.0295	3.0326	3.0357	3.0388	3.0295	3.0357	3.0295
util living area	0.9672	0.9541	0.9200	0.8477	0.7312	0.5509	0.4198	0.4429	0.6790	0.8705	0.9470	0.9715 (86)
MIT	19.1618	19.3509	19.7576	20.2537	20.6543	20.8964	20.9664	20.9613	20.7960	20.3175	19.6856	19.1388 (87)
Th 2	19.8864	19.8915	19.8899	19.8931	19.8931	19.8947	19.8962	19.8977	19.8992	19.8947	19.8977	19.8947 (88)
util rest of house	0.9609	0.9453	0.9044	0.8171	0.6751	0.4632	0.3097	0.3283	0.5982	0.8367	0.9349	0.9659 (89)
MIT 2	17.4754	17.7498	18.3288	19.0196	19.5442	19.8186	19.8809	19.8798	19.7270	19.1244	18.2400	17.4480 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	17.7564	18.0165	18.5669	19.2252	19.7292	19.9982	20.0618	20.0600	19.9051	19.3232	18.4808	17.7297 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6064	17.8665	18.4169	19.0752	19.5792	19.8482	19.9118	19.9100	19.7551	19.1732	18.3308	17.5797 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9420	0.9231	0.8772	0.7898	0.6571	0.4592	0.3113	0.3296	0.5862	0.8088	0.9111	0.9485 (94)
Useful gains	851.8727	932.8291	1005.6667	1017.6312	881.2032	636.9230	410.2511	407.8794	660.6867	798.8560	814.2645	805.1341 (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	1913.3764	1882.5530	1713.2101	1432.0800	1058.7718	679.1435	419.2054	418.3024	751.3895	1160.7002	1552.7412	1878.4162 (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	789.7587	638.2145	526.4122	298.4031	132.1110	0.0000	0.0000	0.0000	0.0000	269.2120	531.7033	798.5219 (98)
Space heating												3984.3367 (98)
RHI space heating demand												3984 (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) =					Air changes per hour 40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.9200
Infiltration rate					0.3822 (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) =		0.3248 (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	0.4142	0.4060	0.3979	0.3573	0.3492	0.3086	0.3086	0.3005	0.3248	0.3492	0.3654	0.3817 (22b)
Effective ac	0.5858	0.5824	0.5792	0.5638	0.5610	0.5476	0.5476	0.5451	0.5528	0.5610	0.5668	0.5728 (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	56.7869	56.4640	56.1476	54.6611	54.3830	53.0883	53.0883	52.8486	53.5870	54.3830	54.9456	55.5338 (38)
Heat transfer coeff	153.2592	152.9364	152.6199	151.1334	150.8553	149.5606	149.5606	149.3209	150.0593	150.8553	151.4179	152.0061 (39)
Average = Sum(39)m / 12 =												151.1321 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2642	1.2615	1.2589	1.2467	1.2444	1.2337	1.2337	1.2317	1.2378	1.2444	1.2490	1.2539 (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)

CALCULATION OF ENERGY RATINGS 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					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	29.6596	29.7222	29.7839	30.0768	30.1322	30.3931	30.3931	30.4419	30.2921	30.1322	30.0203	29.9041
alpha	2.9773	2.9815	2.9856	3.0051	3.0088	3.0262	3.0262	3.0295	3.0195	3.0088	3.0014	2.9936
util living area	0.9737	0.9592	0.9319	0.8744	0.7751	0.6314	0.4939	0.5408	0.7438	0.9024	0.9605	0.9774 (86)
MIT	18.9725	19.2172	19.6105	20.1111	20.5425	20.8295	20.9405	20.9205	20.7030	20.1416	19.4673	18.9242 (87)
Th 2	19.8690	19.8711	19.8731	19.8828	19.8847	19.8931	19.8931	19.8947	19.8899	19.8847	19.8810	19.8771 (88)
util rest of house	0.9686	0.9515	0.9185	0.8487	0.7273	0.5511	0.3847	0.4313	0.6739	0.8768	0.9516	0.9730 (89)
MIT 2	17.1912	17.5449	18.1097	18.8189	19.3978	19.7516	19.8601	19.8471	19.6164	18.8780	17.9170	17.1263 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.4880	17.8236	18.3598	19.0342	19.5886	19.9312	20.0402	20.0259	19.7974	19.0886	18.1753	17.4259 (92)
Temperature adjustment	-0.1500											
adjusted MIT	17.3380	17.6736	18.2098	18.8842	19.4386	19.7812	19.8902	19.8759	19.6474	18.9386	18.0253	17.2759 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9517	0.9301	0.8921	0.8202	0.7051	0.5422	0.3844	0.4293	0.6562	0.8485	0.9304	0.9577 (94)

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Useful gains	820.7578	922.2675	991.8951	1011.5794	925.2529	698.8480	473.1915	492.1814	692.8289	794.3347	784.7905	782.0062 (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	1998.1940	1953.5450	1787.1460	1508.9479	1167.4038	774.9059	492.0784	519.0299	832.4431	1257.9192	1654.2934	1987.6119 (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	876.0125	693.0184	591.6667	358.1053	180.1603	0.0000	0.0000	0.0000	0.0000	344.9068	626.0421	896.9706 (98)
Space heating per m2												4566.8828 (98)
										(98) / (4) =		37.6712 (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												5074.3142 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	876.0125	693.0184	591.6667	358.1053	180.1603	0.0000	0.0000	0.0000	0.0000	344.9068	626.0421	896.9706 (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)	973.3473	770.0205	657.4074	397.8948	200.1781	0.0000	0.0000	0.0000	0.0000	383.2298	695.6023	996.6340 (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	89.3988	89.3461	89.2362	88.9926	88.4873	86.7000	86.7000	86.7000	86.7000	88.9397	89.2770	86.7000 (216)
(217)m												89.4241 (217)
Fuel for water heating, kWh/month	210.2738	184.6677	192.3457	170.3456	166.0044	148.6420	140.1636	157.3985	158.2624	176.8687	189.5118	204.3000 (219)
Water heating fuel used												2098.7845 (219)
Annual totals kWh/year												
Space heating fuel - main system												5074.3142 (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												7059.6763 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5074.3142	3.4800	176.5861 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2098.7845	3.4800	73.0377 (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			354.6634 (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] =	0.8961 (257)
SAP value		87.4994
SAP rating (Section 12)		87 (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	5074.3142	0.2160	1096.0519 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2098.7845	0.2160	453.3374 (264)
Space and water heating			1549.3893 (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			1490.5231 (272)
CO2 emissions per m2			12.3000 (273)
EI value			87.9847
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	$3.48 / 0.8833 = 3.940$, stars = 4
Water heating environmental impact	$0.216 / 0.8833 = 0.2446$, stars = 4

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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							4.9200					
Infiltration rate							0.3822 (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) =	0.3248 (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	0.3411	0.3167	0.3248	0.3086	0.3086	0.3005	0.2924	0.2842	0.2761	0.3005	0.2842	0.3005 (22b)
Effective ac	0.5582	0.5502	0.5528	0.5476	0.5476	0.5451	0.5427	0.5404	0.5381	0.5451	0.5404	0.5451 (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	54.1113	53.3345	53.5870	53.0883	53.0883	52.8486	52.6152	52.3882	52.1677	52.8486	52.3882	52.8486 (38)
Heat transfer coeff	150.5836	149.8068	150.0593	149.5606	149.5606	149.3209	149.0875	148.8606	148.6400	149.3209	148.8606	149.3209 (39)
Average = Sum(39)m / 12 =												149.4152 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2421	1.2357	1.2378	1.2337	1.2337	1.2317	1.2298	1.2279	1.2261	1.2317	1.2279	1.2317 (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)

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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	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	30.1866	30.3431	30.2921	30.3931	30.3931	30.4419	30.4895	30.5360	30.5813	30.4419	30.5360	30.4419
alpha	3.0124	3.0229	3.0195	3.0262	3.0262	3.0295	3.0326	3.0357	3.0388	3.0295	3.0357	3.0295
util living area	0.9672	0.9541	0.9200	0.8477	0.7312	0.5509	0.4198	0.4429	0.6790	0.8705	0.9470	0.9715 (86)
MIT	19.1618	19.3509	19.7576	20.2537	20.6543	20.8964	20.9664	20.9613	20.7960	20.3175	19.6856	19.1388 (87)
Th 2	19.8864	19.8915	19.8899	19.8931	19.8931	19.8947	19.8962	19.8977	19.8992	19.8947	19.8977	19.8947 (88)
util rest of house	0.9609	0.9453	0.9044	0.8171	0.6751	0.4632	0.3097	0.3283	0.5982	0.8367	0.9349	0.9659 (89)
MIT 2	17.4754	17.7498	18.3288	19.0196	19.5442	19.8186	19.8809	19.8798	19.7270	19.1244	18.2400	17.4480 (90)
Living area fraction												fLA = Living area / (4) = 0.1666 (91)
MIT	17.7564	18.0165	18.5669	19.2252	19.7292	19.9982	20.0618	20.0600	19.9051	19.3232	18.4808	17.7297 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6064	17.8665	18.4169	19.0752	19.5792	19.8482	19.9118	19.9100	19.7551	19.1732	18.3308	17.5797 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9420	0.9231	0.8772	0.7898	0.6571	0.4592	0.3113	0.3296	0.5862	0.8088	0.9111	0.9485 (94)

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Useful gains	851.8727	932.8291	1005.6667	1017.6312	881.2032	636.9230	410.2511	407.8794	660.6867	798.8560	814.2645	805.1341 (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	1913.3764	1882.5530	1713.2101	1432.0800	1058.7718	679.1435	419.2054	418.3024	751.3895	1160.7002	1552.7412	1878.4162 (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	789.7587	638.2145	526.4122	298.4031	132.1110	0.0000	0.0000	0.0000	0.0000	269.2120	531.7033	798.5219 (98)
Space heating												3984.3367 (98)
Space heating per m2											(98) / (4) =	32.8659 (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												4427.0408 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	789.7587	638.2145	526.4122	298.4031	132.1110	0.0000	0.0000	0.0000	0.0000	269.2120	531.7033	798.5219 (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)	877.5097	709.1272	584.9025	331.5590	146.7900	0.0000	0.0000	0.0000	0.0000	299.1245	590.7814	887.2465 (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	89.3462	89.3018	89.1655	88.8606	88.2319	86.7000	86.7000	86.7000	86.7000	88.7541	89.1806	86.7000 (216)
(217)m	89.3462	89.3018	89.1655	88.8606	88.2319	86.7000	86.7000	86.7000	86.7000	88.7541	89.1806	89.3667 (217)
Fuel for water heating, kWh/month	210.3977	184.7593	192.4983	170.5986	166.4849	148.6420	140.1636	157.3985	158.2624	177.2386	189.7167	204.4312 (219)
Water heating fuel used												2100.5919 (219)
Annual totals kWh/year												
Space heating fuel - main system												4427.0408 (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												6337.7953 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4427.0408	3.9400	174.4254 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2100.5919	3.9400	82.7633 (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			312.7706 (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	4427.0408	0.2160	956.2408 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2100.5919	0.2160	453.7279 (264)
Space and water heating			1409.9687 (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			1311.4430 (272)

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

Energy Primary energy factor Primary energy

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	kWh/year	kg CO2/kWh	kWh/year
Space heating - main system 1	4427.0408	1.2200	5400.9898 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2100.5919	1.2200	2562.7221 (264)
Space and water heating			7963.7119 (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			7380.9109 (272)
Primary energy kWh/m2/year			60.8835 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
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 88	B 90
Total Savings	£33 1.65 kg/m²		

Potential energy efficiency rating: B 88
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	£274	£274	£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	£313	£280	£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) =					Air changes per hour 40.0000 / (5) = 0.1362 (8)
Pressure test					Yes
Measured/design AP50					4.9200
Infiltration rate					0.3822 (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) =		0.3248 (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	0.4142	0.4060	0.3979	0.3573	0.3492	0.3086	0.3086	0.3005	0.3248	0.3492	0.3654	0.3817 (22b)
Effective ac	0.5858	0.5824	0.5792	0.5638	0.5610	0.5476	0.5476	0.5451	0.5528	0.5610	0.5668	0.5728 (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	56.7869	56.4640	56.1476	54.6611	54.3830	53.0883	53.0883	52.8486	53.5870	54.3830	54.9456	55.5338 (38)
Average = Sum(39)m / 12 =	153.2592	152.9364	152.6199	151.1334	150.8553	149.5606	149.5606	149.3209	150.0593	150.8553	151.4179	152.0061 (39)
												151.1321 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2642	1.2615	1.2589	1.2467	1.2444	1.2337	1.2337	1.2317	1.2378	1.2444	1.2490	1.2539 (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)
												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 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	29.6596	29.7222	29.7839	30.0768	30.1322	30.3931	30.3931	30.4419	30.2921	30.1322	30.0203	29.9041
alpha	2.9773	2.9815	2.9856	3.0051	3.0088	3.0262	3.0262	3.0295	3.0195	3.0088	3.0014	2.9936
util living area	0.9737	0.9592	0.9319	0.8744	0.7751	0.6314	0.4939	0.5408	0.7438	0.9024	0.9605	0.9774 (86)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	18.9725	19.2172	19.6105	20.1111	20.5425	20.8295	20.9405	20.9205	20.7030	20.1416	19.4673	18.9242 (87)
Th 2	19.8690	19.8711	19.8731	19.8828	19.8847	19.8931	19.8931	19.8947	19.8899	19.8847	19.8810	19.8771 (88)
util rest of house												
	0.9686	0.9515	0.9185	0.8487	0.7273	0.5511	0.3847	0.4313	0.6739	0.8768	0.9516	0.9730 (89)
MIT 2	17.1912	17.5449	18.1097	18.8189	19.3978	19.7516	19.8601	19.8471	19.6164	18.8780	17.9170	17.1263 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	17.4880	17.8236	18.3598	19.0342	19.5886	19.9312	20.0402	20.0259	19.7974	19.0886	18.1753	17.4259 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3380	17.6736	18.2098	18.8842	19.4386	19.7812	19.8902	19.8759	19.6474	18.9386	18.0253	17.2759 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9517	0.9301	0.8921	0.8202	0.7051	0.5422	0.3844	0.4293	0.6562	0.8485	0.9304	0.9577 (94)
Useful gains	820.7578	922.2675	991.8951	1011.5794	925.2529	698.8480	473.1915	492.1814	692.8289	794.3347	784.7905	782.0062 (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	1998.1940	1953.5450	1787.1460	1508.9479	1167.4038	774.9059	492.0784	519.0299	832.4431	1257.9192	1654.2934	1987.6119 (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	876.0125	693.0184	591.6667	358.1053	180.1603	0.0000	0.0000	0.0000	0.0000	344.9068	626.0421	896.9706 (98)
Space heating												4566.8828 (98)
Space heating per m2										(98) / (4) =		37.6712 (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													5074.3142 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	876.0125	693.0184	591.6667	358.1053	180.1603	0.0000	0.0000	0.0000	0.0000	344.9068	626.0421	896.9706 (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)	973.3473	770.0205	657.4074	397.8948	200.1781	0.0000	0.0000	0.0000	0.0000	383.2298	695.6023	996.6340 (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	89.4673	89.4887	89.5111	89.5505	89.5583	86.7000	86.7000	86.7000	86.7000	89.2198	89.3822	86.7000 (216)	
Fuel for water heating, kWh/month	181.5910	136.7899	110.7351	60.7495	29.9452	12.4803	5.8013	40.0055	66.3201	115.3008	155.4256	180.3061 (219)	
Water heating fuel used												1095.4504 (219)	
Annual totals kWh/year													
Space heating fuel - main system												5074.3142 (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												6106.3422 (238)	

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5074.3142	3.4800	176.5861 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1095.4504	3.4800	38.1217 (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			326.3424 (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)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8245 (257)
SAP value		88.4976
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	5074.3142	0.2160	1096.0519	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1095.4504	0.2160	236.6173	(264)
Space and water heating			1332.6692	(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			1299.7529	(272)
CO2 emissions per m2			10.7200	(273)
EI value			89.5225	
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		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												4.9200	
Infiltration rate												0.3822 (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) =		0.3248 (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	0.3411	0.3167	0.3248	0.3086	0.3086	0.3005	0.2924	0.2842	0.2761	0.3005	0.2842	0.3005	(22b)
Effective ac	0.5582	0.5502	0.5528	0.5476	0.5476	0.5451	0.5427	0.5404	0.5381	0.5451	0.5404	0.5451	(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 54.1113	Feb 53.3345	Mar 53.5870	Apr 53.0883	May 53.0883	Jun 52.8486	Jul 52.6152	Aug 52.3882	Sep 52.1677	Oct 52.8486	Nov 52.3882	Dec 52.8486 (38)
Heat transfer coeff	150.5836	149.8068	150.0593	149.5606	149.5606	149.3209	149.0875	148.8606	148.6400	149.3209	148.8606	149.3209 (39)
Average = Sum(39)m / 12 =												149.4152 (39)
HLP	Jan 1.2421	Feb 1.2357	Mar 1.2378	Apr 1.2337	May 1.2337	Jun 1.2317	Jul 1.2298	Aug 1.2279	Sep 1.2261	Oct 1.2317	Nov 1.2279	Dec 1.2317 (40)
HLP (average)												1.2325 (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)
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)
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)
Total per year (kWh/year) = Sum(64)m = 939.8209 (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	
						W/m2		or Table 6b		or Table 6c		Table 6d			
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	30.1866	30.3431	30.2921	30.3931	30.3931	30.4419	30.4895	30.5360	30.5813	30.4419	30.5360	30.4419
alpha	3.0124	3.0229	3.0195	3.0262	3.0262	3.0295	3.0326	3.0357	3.0388	3.0295	3.0357	3.0295
util living area	0.9672	0.9541	0.9200	0.8477	0.7312	0.5509	0.4198	0.4429	0.6790	0.8705	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	19.1618	19.3509	19.7576	20.2537	20.6543	20.8964	20.9664	20.9613	20.7960	20.3175	19.6856	19.1388 (87)
Th 2	19.8864	19.8915	19.8899	19.8931	19.8931	19.8947	19.8962	19.8977	19.8992	19.8947	19.8977	19.8947 (88)
util rest of house												
	0.9609	0.9453	0.9044	0.8171	0.6751	0.4632	0.3097	0.3283	0.5982	0.8367	0.9349	0.9659 (89)
MIT 2	17.4754	17.7498	18.3288	19.0196	19.5442	19.8186	19.8809	19.8798	19.7270	19.1244	18.2400	17.4480 (90)
Living area fraction									fLA = Living area / (4) =			0.1666 (91)
MIT	17.7564	18.0165	18.5669	19.2252	19.7292	19.9982	20.0618	20.0600	19.9051	19.3232	18.4808	17.7297 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6064	17.8665	18.4169	19.0752	19.5792	19.8482	19.9118	19.9100	19.7551	19.1732	18.3308	17.5797 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9420	0.9231	0.8772	0.7898	0.6571	0.4592	0.3113	0.3296	0.5862	0.8088	0.9111	0.9485	(94)
Useful gains	851.8727	932.8291	1005.6667	1017.6312	881.2032	636.9230	410.2511	407.8794	660.6867	798.8560	814.2645	805.1341	(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	1913.3764	1882.5530	1713.2101	1432.0800	1058.7718	679.1435	419.2054	418.3024	751.3895	1160.7002	1552.7412	1878.4162	(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	789.7587	638.2145	526.4122	298.4031	132.1110	0.0000	0.0000	0.0000	0.0000	269.2120	531.7033	798.5219	(98)
Space heating												3984.3367	(98)
Space heating per m2											(98) / (4) =	32.8659	(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													4427.0408 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	789.7587	638.2145	526.4122	298.4031	132.1110	0.0000	0.0000	0.0000	0.0000	269.2120	531.7033	798.5219 (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)	877.5097	709.1272	584.9025	331.5590	146.7900	0.0000	0.0000	0.0000	0.0000	299.1245	590.7814	887.2465 (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 (217)m	89.4323	89.4518	89.4630	89.4863	89.3522	86.7000	86.7000	86.7000	86.7000	89.0907	89.3164	86.7000 (216)	
Fuel for water heating, kWh/month	176.7620	136.9200	110.1769	59.2274	34.7922	5.9681	0.4902	32.3866	60.3867	110.7168	149.8344	176.7794 (219)	
Water heating fuel used												1054.4407 (219)	
Annual totals kWh/year													
Space heating fuel - main system												4427.0408 (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												5341.6440 (238)	

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4427.0408	3.9400	174.4254 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	1054.4407	3.9400	41.5450 (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			279.8273 (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	4427.0408	0.2160	956.2408 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1054.4407	0.2160	227.7592 (264)
Space and water heating			1184.0000 (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			1111.4244 (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	4427.0408	1.2200	5400.9898 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1054.4407	1.2200	1286.4176 (264)
Space and water heating			6687.4074 (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			6258.1064 (272)
Primary energy kWh/m2/year			51.6218 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-179	Issued on Date	03/12/2018
Assessment Reference	As Built	Prop Type Ref	P409 - Det (Op)
Property	8, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE		
SAP Rating	87 B	DER	13.60
Environmental	88 B	TER	16.73
CO ₂ Emissions (t/year)	1.31	% DER<TER	18.73
General Requirements Compliance	Pass	DFEE	50.40
		TTEE	54.74
		% DFEE<TFEE	7.92
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	Ratio	Z_overhangs	Overhang type
Orientation			
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	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
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 g or Table 6b	FF Specific data or Table 6c	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			