

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-210				Issued on Date	28/05/2019
Assessment Reference	As Built	Prop Type Ref	SHL2.5 - Semi (As)			
Property	45, St Andrews Road, Botley, SOUTHAMPTON, SO32 2ST					
SAP Rating	88 B	DER	12.62	TER	15.99	
Environmental	89 B	% DER<TER	21.10			
CO ₂ Emissions (t/year)	1.05	DFEE	42.58	TFEE	47.74	
General Requirements Compliance	Pass	% DFEE<TFEE	10.80			
Assessor Details	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk				Assessor ID	T511-0001
Client						

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

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DWELLING AS BUILT

Semi-Detached House, total floor area 110 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) 15.99 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.62 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)47.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.30 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.16 (max. 0.25)	0.16 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.30 (max. 0.35)	OK
Openings	1.36 (max. 2.00)	1.80 (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: 4.51 (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 28 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 East: 4.68 m², No overhang
Windows facing South: 2.91 m², No overhang
Windows facing West: 7.56 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

External wall U-value 0.12 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.12 W/m²K
Door U-value 0.90 W/m²K
Thermal bridging y-value 0.039 W/m²K
Photovoltaic array 0.81 kW

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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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.5100
Infiltration rate					0.3771 (18)
Number of sides sheltered					1 (19)
Shelter factor					(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.3488 (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	0.4447	0.4360	0.4273	0.3837	0.3749	0.3313	0.3313	0.3226	0.3488	0.3749	0.3924	0.4098 (22b)
Effective ac	0.5989	0.5950	0.5913	0.5736	0.5703	0.5549	0.5549	0.5520	0.5608	0.5703	0.5770	0.5840 (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 FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
Thermal mass parameter (TMP) = Cm / TFA in kJ/m²K 171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
Total fabric heat loss (33) + (36) = 67.7339 (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	52.1600	51.8256	51.4978	49.9582	49.6702	48.3293	48.3293	48.0809	48.8458	49.6702	50.2529	50.8621 (38)
Heat transfer coeff	119.8938	119.5594	119.2317	117.6921	117.4040	116.0631	116.0631	115.8148	116.5796	117.4040	117.9868	118.5960 (39)
Average = Sum(39)m / 12 =												117.6907 (39)
HLP	1.0880	1.0849	1.0820	1.0680	1.0654	1.0532	1.0532	1.0510	1.0579	1.0654	1.0707	1.0762 (40)
HLP (average)												1.0680 (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	2.8160 (42)											
Average daily hot water use (litres/day)	101.0805 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866
Energy content (annual)	Total = Sum(45)m =											1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530
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
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
Combi loss	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390
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
Solar input (sum of months) = Sum(63)m =	0.0000 (63)											
Output from w/h	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390
Total per year (kWh/year) = Sum(64)m =	1846.2641 (64)											
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589

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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801
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
Losses e.g. evaporation (negative values) (Table 5)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082
Total internal gains	446.8571	444.4582	428.2167	401.9524	374.9954	349.3514	332.9348	339.5802	353.3030	379.7987	410.1842	433.2450

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			
East				4.6800	19.6403	0.6200	0.7000	0.7700	27.6450 (76)			
South				2.9100	46.7521	0.6200	0.7000	0.7700	40.9182 (78)			
West				1.7600	19.6403	0.6200	0.7000	0.7700	10.3964 (80)			
West				5.8000	19.6403	0.6200	0.7000	0.7700	34.2609 (80)			
West				0.8600	26.0000	0.6300	0.7000	1.0000	8.8747 (82)			

Solar gains	122.0951	226.8840	351.0604	487.3923	582.4045	591.2092	564.7954	493.9277	399.3316	262.6371	149.9185	101.9830 (83)
Total gains	568.9522	671.3422	779.2771	889.3448	957.3999	940.5606	897.7302	833.5079	752.6346	642.4358	560.1026	535.2279 (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	43.8199	43.9425	44.0633	44.6397	44.7492	45.2662	45.2662	45.3633	45.0657	44.7492	44.5282	44.2995
alpha	3.9213	3.9295	3.9376	3.9760	3.9833	4.0177	4.0177	4.0242	4.0044	3.9833	3.9685	3.9533
util living area	0.9948	0.9896	0.9757	0.9361	0.8482	0.6971	0.5418	0.5966	0.8259	0.9617	0.9907	0.9959
MIT	19.3479	19.5489	19.8843	20.3162	20.6763	20.8989	20.9719	20.9588	20.7881	20.3023	19.7464	19.3164
Th 2	20.0107	20.0132	20.0156	20.0271	20.0292	20.0392	20.0392	20.0411	20.0354	20.0292	20.0249	20.0203
util rest of house	0.9936	0.9871	0.9696	0.9194	0.8077	0.6198	0.4350	0.4893	0.7652	0.9485	0.9880	0.9950
MIT 2	17.7896	18.0839	18.5715	19.1941	19.6826	19.9570	20.0245	20.0175	19.8384	19.1861	18.3810	17.7499
Living area fraction	18.0133	18.2942	18.7599	19.3552	19.8252	20.0922	20.1605	20.1526	19.9748	19.3463	18.5770	0.1436
MIT	17.8633	18.1442	18.6099	19.2052	19.6752	19.9422	20.0105	20.0026	19.8248	19.1963	18.4270	17.8248

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9894	0.9799	0.9574	0.9012	0.7903	0.6112	0.4316	0.4847	0.7494	0.9328	0.9813	0.9915
	562.8976	657.8722	746.0676	801.4865	756.6683	574.8422	387.4485	403.9604	564.0581	599.2631	549.6474	530.6717

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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	1626.1592	1583.4682	1443.8869	1212.8432	936.3265	620.0371	395.8298	417.2374	667.3922	1009.2456	1336.4384	1615.8474 (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	791.0666	622.0005	519.1776	296.1768	133.6657	0.0000	0.0000	0.0000	0.0000	305.0270	566.4895	807.3707 (98)
Space heating												4040.9743 (98)
Space heating per m2											(98) / (4) =	36.6695 (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												4489.9715 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	791.0666	622.0005	519.1776	296.1768	133.6657	0.0000	0.0000	0.0000	0.0000	305.0270	566.4895	807.3707 (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)	878.9629	691.1117	576.8640	329.0853	148.5174	0.0000	0.0000	0.0000	0.0000	338.9189	629.4328	897.0786 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Efficiency of water heater	89.3504	89.2910	89.1606	88.8591	88.2456	86.7000	86.7000	86.7000	86.7000	88.8534	89.2226	86.7000 (216)
Fuel for water heating, kWh/month	209.0249	183.6140	191.3623	169.6774	165.6281	148.0073	139.6691	156.6973	157.5142	176.0827	188.4772	203.1194 (219)
Water heating fuel used												2088.8739 (219)
Annual totals kWh/year												
Space heating fuel - main system												4489.9715 (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)												454.4468 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 908 * 1.00) =									-588.2895			-588.2895 (233)
Total delivered energy for all uses												6520.0026 (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	4489.9715	0.2160	969.8338 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2088.8739	0.2160	451.1968 (264)
Space and water heating			1421.0306 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-588.2895	0.5190	-305.3223 (269)
Total CO2, kg/year			1390.4912 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.6200 (273)

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

DER		12.6200 ZC1
Total Floor Area		110.2000
Assumed number of occupants	TFA	2.8160
CO2 emission factor in Table 12 for electricity displaced from grid	N	0.5190
CO2 emissions from appliances, equation (L14)	EF	14.6178 ZC2
CO2 emissions from cooking, equation (L16)		1.6931 ZC3
Total CO2 emissions		28.9310 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		28.9310 ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4016 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3714 (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	0.4736	0.4643	0.4550	0.4086	0.3993	0.3529	0.3529	0.3436	0.3714	0.3993	0.4179	0.4364 (22b)
Effective ac	0.6121	0.6078	0.6035	0.5835	0.5797	0.5623	0.5623	0.5590	0.5690	0.5797	0.5873	0.5952 (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			1.9600	1.0000	1.9600		(26)
TER Opening Type (Uw = 1.40)			15.1500	1.3258	20.0852		(27)
TER Room Window (Uw = 1.70)			0.8600	1.5918	1.3689		(27a)
Jet Floor Lo			39.0300	0.1300	5.0739		(28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.1800	15.4818		(29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.1800	0.5076		(29a)
Wall to void	14.0000		14.0000	0.1800	2.5200		(29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178		(30)
Ceiling to Void	6.8900		6.8900	0.1300	0.8957		(30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1300	2.1398		(30)
Dormer Flat Roof	1.7800		1.7800	0.1300	0.2314		(30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.4821		(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)							11.0261 (36)
Total fabric heat loss						(33) + (36) =	63.5082 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	53.3154	52.9362	52.5644	50.8183	50.4916	48.9707	48.9707	48.6891	49.5565	50.4916	51.1525	51.8434 (38)
Average = Sum(39)m / 12 =	116.8237	116.4444	116.0727	114.3265	113.9998	112.4790	112.4790	112.1974	113.0648	113.9998	114.6607	115.3517 (39)
												114.3250 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0601	1.0567	1.0533	1.0374	1.0345	1.0207	1.0207	1.0181	1.0260	1.0345	1.0405	1.0467 (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												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy conte	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m = 1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	48.8510	48.4189	44.8631	46.3586	48.4189	48.8510	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	215.8483	190.2407	199.7741	178.5917	172.9083	152.2879	145.9035	162.6482	164.4444	185.6720	196.3649	210.6455 (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	215.8483	190.2407	199.7741	178.5917	172.9083	152.2879	145.9035	162.6482	164.4444	185.6720	196.3649	210.6455 (64)
												Total per year (kWh/year) = Sum(64)m = 2175.3295 (64)
Heat gains from water heating, kWh/month	67.5655	59.4578	62.2208	55.3515	53.4974	46.9345	44.6883	50.0859	50.6476	57.5318	61.2228	65.8355 (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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	(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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	(71)
Water heating gains (Table 5)	90.8138	88.4788	83.6301	76.8771	71.9052	65.1869	60.0649	67.3198	70.3438	77.3277	85.0317	88.4886	(72)
Total internal gains	456.6298	454.2386	438.0132	411.6115	383.9836	357.6728	341.2716	348.5828	362.9835	389.6161	419.9760	443.0254	(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
East			4.6800		19.6403		0.6300		0.7000		0.7700		28.0909 (76)
South			2.9100		46.7521		0.6300		0.7000		0.7700		41.5782 (78)
West			7.5600		19.6403		0.6300		0.7000		0.7700		45.3775 (80)
West			0.8600		26.0000		0.6300		0.7000		1.0000		8.8747 (82)
Solar gains	123.9213	230.2462	356.1942	494.4277	590.7411	599.6438	572.8645	501.0299	405.1393	266.5098	152.1548	103.5122	(83)
Total gains	580.5511	684.4848	794.2074	906.0392	974.7247	957.3166	914.1361	849.6127	768.1228	656.1259	572.1308	546.5376	(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	65.5071	65.7204	65.9309	66.9379	67.1297	68.0374	68.0374	68.2082	67.6849	67.1297	66.7428	66.3430
alpha	5.3671	5.3814	5.3954	5.4625	5.4753	5.5358	5.5358	5.5472	5.5123	5.4753	5.4495	5.4229
util living area	0.9989	0.9972	0.9907	0.9634	0.8788	0.7064	0.5329	0.5918	0.8529	0.9821	0.9976	0.9992 (86)
MIT	19.8121	19.9664	20.2225	20.5559	20.8227	20.9619	20.9932	20.9884	20.8910	20.5289	20.1104	19.7911 (87)
Th 2	20.0335	20.0364	20.0392	20.0522	20.0547	20.0661	20.0661	20.0683	20.0617	20.0547	20.0497	20.0446 (88)
util rest of house	0.9986	0.9962	0.9874	0.9497	0.8356	0.6213	0.4243	0.4799	0.7862	0.9731	0.9966	0.9990 (89)
MIT 2	18.4367	18.6642	19.0388	19.5240	19.8788	20.0405	20.0636	20.0633	19.9722	19.4945	18.8848	18.4140 (90)
Living area fraction	fLA = Living area / (4) = 0.1436 (91)											
MIT	18.6342	18.8511	19.2087	19.6721	20.0143	20.1728	20.1970	20.1961	20.1041	19.6430	19.0608	18.6117 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.6342	18.8511	19.2087	19.6721	20.0143	20.1728	20.1970	20.1961	20.1041	19.6430	19.0608	18.6117 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9978	0.9945	0.9833	0.9427	0.8335	0.6316	0.4399	0.4958	0.7897	0.9676	0.9950	0.9984	(94)
Useful gains	579.2621	680.6867	780.9714	854.1153	812.4295	604.6719	402.1037	421.2582	606.6103	634.8904	569.2764	545.6567	(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	1674.5730	1624.5294	1475.1340	1231.5388	947.8321	626.8186	404.5906	425.9175	678.8496	1030.8975	1371.4296	1662.4177	(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	814.9113	634.2623	516.4569	271.7449	100.7395	0.0000	0.0000	0.0000	0.0000	294.6293	577.5503	830.8702	(98)
Space heating												4041.1647	(98)
Space heating per m2												(98) / (4) = 36.6712	(99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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												4326.7288 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	814.9113	634.2623	516.4569	271.7449	100.7395	0.0000	0.0000	0.0000	0.0000	294.6293	577.5503	830.8702 (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)	872.4961	679.0817	552.9518	290.9474	107.8581	0.0000	0.0000	0.0000	0.0000	315.4489	618.3622	889.5826 (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	215.8483	190.2407	199.7741	178.5917	172.9083	152.2879	145.9035	162.6482	164.4444	185.6720	196.3649	210.6455 (64)
Efficiency of water heater (217)m	88.0801	87.8505	87.3360	86.1050	83.7444	80.3000	80.3000	80.3000	80.3000	86.2083	87.6042	80.3000 (216)
Fuel for water heating, kWh/month	245.0592	216.5506	228.7420	207.4114	206.4714	189.6487	181.6979	202.5506	204.7876	215.3759	224.1500	238.9425 (219)
Water heating fuel used												2561.3879 (219)
Annual totals kWh/year												
Space heating fuel - main system												4326.7288 (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)												454.4468 (232)
Total delivered energy for all uses												7417.5634 (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	4326.7288	0.2160	934.5734 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2561.3879	0.2160	553.2598 (264)
Space and water heating			1487.8332 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Total CO2, kg/m2/year			1762.6161 (272)
Emissions per m2 for space and water heating			13.5012 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1403 (272b)
Emissions per m2 for pumps and fans			0.3532 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.5012 * 1.00) + 2.1403 + 0.3532, rounded to 2 d.p.			15.9900 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.5100
Infiltration rate					0.3771 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3488 (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	0.4447	0.4360	0.4273	0.3837	0.3749	0.3313	0.3313	0.3226	0.3488	0.3749	0.3924	0.4098 (22b)
Effective ac	0.5989	0.5950	0.5913	0.5736	0.5703	0.5549	0.5549	0.5520	0.5608	0.5703	0.5770	0.5840 (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 FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			9.0000	351.2700 (32e)
Internal Ceiling 1F			32.1400			9.0000	289.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18272.9300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							165.8161 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.9551 (36)
Total fabric heat loss						(33) + (36) =	67.7339 (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	52.1600	51.8256	51.4978	49.9582	49.6702	48.3293	48.3293	48.0809	48.8458	49.6702	50.2529	50.8621 (38)
Heat transfer coeff	119.8938	119.5594	119.2317	117.6921	117.4040	116.0631	116.0631	115.8148	116.5796	117.4040	117.9868	118.5960 (39)
Average = Sum(39)m / 12 =												117.6907 (39)
HLP	1.0880	1.0849	1.0820	1.0680	1.0654	1.0532	1.0532	1.0510	1.0579	1.0654	1.0707	1.0762 (40)
HLP (average)												1.0680 (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 FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8160 (42)											
Average daily hot water use (litres/day)	101.0805 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)	Total = Sum(45)m =											1590.3899 (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	35.0390	30.6453	31.6232	27.5699	26.4540	22.8278	21.1533	24.2737	24.5636	28.6265	31.2481	33.9334 (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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	47.0954	45.6032	42.5044	38.2915	35.5564	31.7052	28.4318	32.6260	34.1161	38.4765	43.4001	45.6094 (72)
Total internal gains	409.9115	408.3629	393.8874	370.0259	344.6348	321.1912	306.6385	310.8889	323.7557	347.7649	375.3444	397.1462 (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			
East				4.6800	19.6403	0.6200	0.7000	0.7700	27.6450 (76)			
South				2.9100	46.7521	0.6200	0.7000	0.7700	40.9182 (78)			
West				1.7600	19.6403	0.6200	0.7000	0.7700	10.3964 (80)			
West				5.8000	19.6403	0.6200	0.7000	0.7700	34.2609 (80)			
West				0.8600	26.0000	0.6300	0.7000	1.0000	8.8747 (82)			
Solar gains	122.0951	226.8840	351.0604	487.3923	582.4045	591.2092	564.7954	493.9277	399.3316	262.6371	149.9185	101.9830 (83)
Total gains	532.0066	635.2470	744.9479	857.4182	927.0393	912.4004	871.4339	804.8166	723.0874	610.4020	525.2629	499.1292 (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	42.3359	42.4543	42.5710	43.1279	43.2337	43.7332	43.7332	43.8270	43.5395	43.2337	43.0202	42.7992
alpha	3.8224	3.8303	3.8381	3.8752	3.8822	3.9155	3.9155	3.9218	3.9026	3.8822	3.8680	3.8533
util living area	0.9954	0.9904	0.9771	0.9392	0.8546	0.7078	0.5538	0.6109	0.8361	0.9649	0.9917	0.9964 (86)
MIT	19.2629	19.4704	19.8175	20.2664	20.6446	20.8845	20.9665	20.9511	20.7625	20.2502	19.6741	19.2312 (87)
Th 2	20.0107	20.0132	20.0156	20.0271	20.0292	20.0392	20.0392	20.0411	20.0354	20.0292	20.0249	20.0203 (88)
util rest of house	0.9943	0.9881	0.9715	0.9234	0.8158	0.6316	0.4461	0.5033	0.7781	0.9529	0.9893	0.9955 (89)
MIT 2	18.4128	18.6211	18.9668	19.4132	19.7664	19.9738	20.0269	20.0213	19.8817	19.4060	18.8338	18.3885 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.5348	18.7430	19.0889	19.5356	19.8924	20.1046	20.1618	20.1548	20.0082	19.5272	18.9545	18.5095 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.5348	18.7430	19.0889	19.5356	19.8924	20.1046	20.1618	20.1548	20.0082	19.5272	18.9545	18.5095 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9920	0.9841	0.9646	0.9136	0.8096	0.6373	0.4606	0.5170	0.7762	0.9449	0.9857	0.9937 (94)
Useful gains	527.7384	625.1541	718.5575	783.3734	750.4913	581.4688	401.3624	416.0744	561.2866	576.7450	517.7748	495.9658 (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	1706.6662	1655.0647	1501.0009	1251.7305	961.8262	638.8755	413.3888	434.8604	688.7708	1048.0874	1398.6707	1697.0436 (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	877.1223	692.0999	582.1379	337.2171	157.2331	0.0000	0.0000	0.0000	0.0000	350.6787	634.2451	893.6019 (98)
Space heating	4524.3360 (98)											

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Calculation Type: New Build (As Built)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating per m2

(98) / (4) = 41.0557 (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	
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	1090.9935	858.8672	880.1926	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8221	0.8859	0.8581	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	896.9225	760.8964	755.3324	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1165.8777	1116.2507	1042.4391	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	193.6477	264.3836	213.6074	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction													671.6387 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			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	48.4119	66.0959	53.4019	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													167.9097 (107)
Space cooling per m2													1.5237 (108)
Energy for space heating													41.0557 (99)
Energy for space cooling													1.5237 (108)
Total													42.5794 (109)
Dwelling Fabric Energy Efficiency (DFEE)													42.6 (109)

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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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4016 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3714 (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	0.4736	0.4643	0.4550	0.4086	0.3993	0.3529	0.3529	0.3436	0.3714	0.3993	0.4179	0.4364 (22b)
Effective ac	0.6121	0.6078	0.6035	0.5835	0.5797	0.5623	0.5623	0.5590	0.5690	0.5797	0.5873	0.5952 (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			1.9600	1.0000	1.9600		(26)
TER Opening Type (Uw = 1.40)			15.1500	1.3258	20.0852		(27)
TER Room Window (Uw = 1.70)			0.8600	1.5918	1.3689		(27a)
Jet Floor Lo			39.0300	0.1300	5.0739		(28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.1800	15.4818		(29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.1800	0.5076		(29a)
Wall to void	14.0000		14.0000	0.1800	2.5200		(29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178		(30)
Ceiling to Void	6.8900		6.8900	0.1300	0.8957		(30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1300	2.1398		(30)
Dormer Flat Roof	1.7800		1.7800	0.1300	0.2314		(30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.4821		(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)							11.0261 (36)
Total fabric heat loss						(33) + (36) =	63.5082 (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	53.3154	52.9362	52.5644	50.8183	50.4916	48.9707	48.9707	48.6891	49.5565	50.4916	51.1525	51.8434 (38)
Heat transfer coeff	116.8237	116.4444	116.0727	114.3265	113.9998	112.4790	112.4790	112.1974	113.0648	113.9998	114.6607	115.3517 (39)
Average = Sum(39)m / 12 =												114.3250 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0601	1.0567	1.0533	1.0374	1.0345	1.0207	1.0207	1.0181	1.0260	1.0345	1.0405	1.0467 (40)
HLP (average)												1.0374 (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												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy conte	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)

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Energy content (annual)	Total = Sum(45)m = 1590.3899 (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	35.0390	30.6453	31.6232	27.5699	26.4540	22.8278	21.1533	24.2737	24.5636	28.6265	31.2481	33.9334 (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	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	140.8011	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.7327	22.8555	18.5874	14.0718	10.5189	8.8805	9.5957	12.4728	16.7410	21.2565	24.8095	26.4478	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.8431	274.6639	267.5554	252.4222	233.3192	215.3651	203.3707	200.5498	207.6584	222.7916	241.8945	259.8486	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	37.0801	(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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	(71)
Water heating gains (Table 5)	47.0954	45.6032	42.5044	38.2915	35.5564	31.7052	28.4318	32.6260	34.1161	38.4765	43.4001	45.6094	(72)
Total internal gains	409.9115	408.3629	393.8874	370.0259	344.6348	321.1912	306.6385	310.8889	323.7557	347.7649	375.3444	397.1462	(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
East			4.6800		19.6403		0.6300		0.7000		0.7700		28.0909 (76)
South			2.9100		46.7521		0.6300		0.7000		0.7700		41.5782 (78)
West			7.5600		19.6403		0.6300		0.7000		0.7700		45.3775 (80)
West			0.8600		26.0000		0.6300		0.7000		1.0000		8.8747 (82)
Solar gains	123.9213	230.2462	356.1942	494.4277	590.7411	599.6438	572.8645	501.0299	405.1393	266.5098	152.1548	103.5122	(83)
Total gains	533.8327	638.6091	750.0816	864.4536	935.3759	920.8350	879.5030	811.9188	728.8951	614.2747	527.4992	500.6584	(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	65.5071	65.7204	65.9309	66.9379	67.1297	68.0374	68.0374	68.2082	67.6849	67.1297	66.7428	66.3430	
alpha	5.3671	5.3814	5.3954	5.4625	5.4753	5.5358	5.5358	5.5472	5.5123	5.4753	5.4495	5.4229	
util living area	0.9993	0.9980	0.9929	0.9698	0.8933	0.7272	0.5523	0.6159	0.8737	0.9866	0.9984	0.9995	(86)
MIT	19.7719	19.9272	20.1860	20.5258	20.8044	20.9561	20.9920	20.9860	20.8750	20.4955	20.0720	19.7514	(87)
Th 2	20.0335	20.0364	20.0392	20.0522	20.0547	20.0661	20.0661	20.0683	20.0617	20.0547	20.0497	20.0446	(88)
util rest of house	0.9991	0.9973	0.9902	0.9581	0.8531	0.6421	0.4405	0.5011	0.8115	0.9797	0.9977	0.9994	(89)
MIT 2	18.9031	19.0605	19.3202	19.6635	19.9202	20.0456	20.0640	20.0641	19.9897	19.6403	19.2162	18.8917	(90)
Living area fraction	19.0278	19.1849	19.4445	19.7873	20.0472	20.1763	20.1972	20.1965	20.1168	19.7630	19.3391	19.0151	(91)
Temperature adjustment	19.0278	19.1849	19.4445	19.7873	20.0472	20.1763	20.1972	20.1965	20.1168	19.7630	19.3391	19.0151	(92)
adjusted MIT	19.0278	19.1849	19.4445	19.7873	20.0472	20.1763	20.1972	20.1965	20.1168	19.7630	19.3391	19.0151	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9987	0.9964	0.9881	0.9539	0.8527	0.6529	0.4567	0.5176	0.8158	0.9767	0.9970	0.9991	(94)
Ext temp.	533.1434	636.3262	741.1266	824.6292	797.6258	601.2374	401.6257	420.2148	594.6283	599.9898	525.9050	500.2037	(95)
Heat loss rate W	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)
Month fracti	1720.5595	1663.3951	1502.5018	1244.7053	951.5754	627.2195	404.6142	425.9526	680.2915	1044.5860	1403.3411	1708.9448	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(98)
Space heating per m2	883.4376	690.1903	566.4631	302.4548	114.5385	0.0000	0.0000	0.0000	0.0000	330.7796	631.7540	899.3033	(99)
												4418.9212	(98)
												40.0991	(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	
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													

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1057.3025	832.3445	852.6999	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8882	0.9431	0.9206	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	939.0546	784.9810	784.9911	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1175.7363	1125.6821	1050.7404	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	170.4108	253.4817	197.7175	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									FC = cooled area / (4) =			621.6099 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	42.6027	63.3704	49.4294	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												155.4025 (107)
Energy for space heating												1.4102 (108)
Energy for space cooling												40.0991 (99)
Total												1.4102 (108)
Target Fabric Energy Efficiency (TFEE)												41.5093 (109)
												47.7 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.5100
Infiltration rate					0.3771 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3488 (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	0.3662	0.3401	0.3488	0.3313	0.3313	0.3226	0.3139	0.3052	0.2965	0.3226	0.3052	0.3226 (22b)
Effective ac	0.5671	0.5578	0.5608	0.5549	0.5549	0.5520	0.5493	0.5466	0.5439	0.5520	0.5466	0.5520 (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 FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	59.7788	(33)
E-WM-28					0.0000	0.0000	110.0000 (32)
GF Timber						9.0000	587.9700 (32c)
1F Timber						9.0000	578.7900 (32c)
2F Timber						9.0000	568.4400 (32c)
Internal Floor 1F						18.0000	702.5400 (32d)
Internal Floor 2F						18.0000	578.5200 (32d)
Internal Ceiling GF						18.0000	702.5400 (32e)
Internal Ceiling 1F						18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
Thermal mass parameter (TMP) = Cm / TFA in kJ/m²K 171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
Total fabric heat loss (33) + (36) = 67.7339 (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	49.3887	48.5842	48.8458	48.3293	48.3293	48.0809	47.8392	47.6042	47.3757	48.0809	47.6042	48.0809 (38)
Heat transfer coeff	117.1226	116.3181	116.5796	116.0631	116.0631	115.8148	115.5731	115.3380	115.1096	115.8148	115.3380	115.8148 (39)
Average = Sum(39)m / 12 =												115.9125 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0628	1.0555	1.0579	1.0532	1.0532	1.0510	1.0488	1.0466	1.0446	1.0510	1.0466	1.0510 (40)
HLP (average)												1.0518 (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 HEAT DEMAND 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)	Total = Sum(45)m =											1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
	Total per year (kWh/year) = Sum(64)m =											1846.2641 (64)
RHI water heating demand												1846 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (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
East				4.6800	25.1925		0.6200		0.7000		0.7700		35.4602 (76)
South				2.9100	56.7559		0.6200		0.7000		0.7700		49.6737 (78)
West				1.7600	25.1925		0.6200		0.7000		0.7700		13.3354 (80)
West				5.8000	25.1925		0.6200		0.7000		0.7700		43.9464 (80)
West				0.8600	34.0000		0.6300		0.7000		1.0000		11.6054 (82)
Solar gains	154.0211	243.7979	380.4230	531.2792	603.2859	665.2600	630.5379	565.0658	457.0155	304.5589	188.5601	126.4240	(83)
Total gains	819.1622	903.6138	1014.0940	1124.4590	1154.7703	1179.7997	1123.8261	1067.9257	983.5017	871.7678	800.8928	773.1181	(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	44.8567	45.1670	45.0657	45.2662	45.2662	45.3633	45.4581	45.5508	45.6412	45.3633	45.5508	45.3633
alpha	3.9904	4.0111	4.0044	4.0177	4.0177	4.0242	4.0305	4.0367	4.0427	4.0242	4.0367	4.0242
util living area	0.9794	0.9690	0.9379	0.8629	0.7333	0.5344	0.3950	0.4137	0.6654	0.8850	0.9622	0.9825 (86)
MIT	19.7460	19.8978	20.2109	20.5771	20.8378	20.9655	20.9920	20.9907	20.9177	20.6049	20.1397	19.7307 (87)
Th 2	20.0313	20.0373	20.0354	20.0392	20.0392	20.0411	20.0429	20.0447	20.0464	20.0411	20.0447	20.0411 (88)
util rest of house	0.9747	0.9622	0.9241	0.8329	0.6776	0.4537	0.3009	0.3159	0.5869	0.8521	0.9523	0.9785 (89)
MIT 2	18.3805	18.6027	19.0467	19.5521	19.8820	20.0176	20.0396	20.0408	19.9813	19.6025	18.9587	18.3655 (90)
Living area fraction	fLA = Living area / (4) = 0.1436 (91)											
MIT	18.5766	18.7886	19.2138	19.6993	20.0192	20.1537	20.1764	20.1771	20.1157	19.7464	19.1282	18.5615 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.4266	18.6386	19.0638	19.5493	19.8692	20.0037	20.0264	20.0271	19.9657	19.5964	18.9782	18.4115 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9639	0.9488	0.9065	0.8151	0.6668	0.4504	0.2993	0.3141	0.5797	0.8335	0.9374	0.9687 (94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Useful gains	789.6076	857.3799	919.2816	916.5194	769.9805	531.3996	336.3338	335.3935	570.1344	726.6459	750.7748	748.9579	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
Month fracti	1584.2668	1551.5203	1406.3915	1166.3512	855.2904	544.7558	338.2077	337.6109	606.1365	949.2664	1277.7382	1553.2463	(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	591.2264	466.4623	362.4098	179.8789	63.4706	0.0000	0.0000	0.0000	0.0000	165.6297	379.4136	598.3906	(98)
RHI space heating demand												2806.8819	(98)
												2807	(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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.5100
Infiltration rate					0.3771 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3488 (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	0.4447	0.4360	0.4273	0.3837	0.3749	0.3313	0.3313	0.3226	0.3488	0.3749	0.3924	0.4098 (22b)
Effective ac	0.5989	0.5950	0.5913	0.5736	0.5703	0.5549	0.5549	0.5520	0.5608	0.5703	0.5770	0.5840 (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 FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
Thermal mass parameter (TMP) = Cm / TFA in kJ/m²K 171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
Total fabric heat loss (33) + (36) = 67.7339 (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	52.1600	51.8256	51.4978	49.9582	49.6702	48.3293	48.3293	48.0809	48.8458	49.6702	50.2529	50.8621 (38)
Heat transfer coeff	119.8938	119.5594	119.2317	117.6921	117.4040	116.0631	116.0631	115.8148	116.5796	117.4040	117.9868	118.5960 (39)
Average = Sum(39)m / 12 =												117.6907 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0880	1.0849	1.0820	1.0680	1.0654	1.0532	1.0532	1.0510	1.0579	1.0654	1.0707	1.0762 (40)
HLP (average)												1.0680 (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 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8160 (42)											
Average daily hot water use (litres/day)	101.0805 (43)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)	Total = Sum(45)m =											1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (65)
	Total per year (kWh/year) = Sum(64)m =											1846.2641 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (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
East					4.6800	19.6403	0.6200	0.7000			0.7700			27.6450 (76)
South					2.9100	46.7521	0.6200	0.7000			0.7700			40.9182 (78)
West					1.7600	19.6403	0.6200	0.7000			0.7700			10.3964 (80)
West					5.8000	19.6403	0.6200	0.7000			0.7700			34.2609 (80)
West					0.8600	26.0000	0.6300	0.7000			1.0000			8.8747 (82)
Solar gains	122.0951	226.8840	351.0604	487.3923	582.4045	591.2092	564.7954	493.9277	399.3316	262.6371	149.9185			101.9830 (83)
Total gains	787.2363	886.7000	984.7314	1080.5721	1133.8889	1105.7489	1058.0836	996.7876	925.8178	829.8460	762.2511			748.6771 (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	43.8199	43.9425	44.0633	44.6397	44.7492	45.2662	45.2662	45.3633	45.0657	44.7492	44.5282	44.2995
alpha	3.9213	3.9295	3.9376	3.9760	3.9833	4.0177	4.0177	4.0242	4.0044	3.9833	3.9685	3.9533
util living area	0.9842	0.9738	0.9500	0.8922	0.7840	0.6202	0.4689	0.5136	0.7404	0.9194	0.9738	0.9869 (86)
MIT	19.5881	19.7781	20.0860	20.4683	20.7653	20.9338	20.9831	20.9758	20.8622	20.4702	19.9630	19.5538 (87)
Th 2	20.0107	20.0132	20.0156	20.0271	20.0292	20.0392	20.0392	20.0411	20.0354	20.0292	20.0249	20.0203 (88)
util rest of house	0.9807	0.9680	0.9387	0.8677	0.7363	0.5435	0.3725	0.4153	0.6707	0.8958	0.9670	0.9839 (89)
MIT 2	18.1379	18.4138	18.8562	19.3974	19.7869	19.9877	20.0308	20.0279	19.9148	19.4131	18.6919	18.0948 (90)
Living area fraction	18.3461	18.6096	19.0328	19.5511	19.9274	20.1235	20.1675	20.1640	20.0508	19.5648	18.8743	0.1436 (91)
MIT	18.1961	18.4596	18.8828	19.4011	19.7774	19.9735	20.0175	20.0140	19.9008	19.4148	18.7243	18.3043 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.1961	18.4596	18.8828	19.4011	19.7774	19.9735	20.0175	20.0140	19.9008	19.4148	18.7243	18.1543 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9714	0.9554	0.9218	0.8488	0.7224	0.5379	0.3703	0.4124	0.6598	0.8768	0.9544	0.9757 (94)
	764.7158	847.1680	907.7501	917.2326	819.1445	594.7990	391.7962	411.0692	610.8565	727.5938	727.4631	730.4991 (95)

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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	1666.0596	1621.1818	1476.4175	1235.8990	948.3178	623.6695	396.6435	418.5564	676.2600	1034.8967	1371.5177	1654.9183 (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	670.5998	520.1373	423.0886	229.4398	96.1049	0.0000	0.0000	0.0000	0.0000	228.6333	463.7193	687.7679 (98)
Space heating												3319.4909 (98)
Space heating per m2											(98) / (4) =	30.1224 (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												3688.3232 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.5998	520.1373	423.0886	229.4398	96.1049	0.0000	0.0000	0.0000	0.0000	228.6333	463.7193	687.7679 (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)	745.1109	577.9303	470.0984	254.9331	106.7832	0.0000	0.0000	0.0000	0.0000	254.0370	515.2437	764.1866 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Efficiency of water heater	89.2599	89.1864	89.0262	88.6618	87.9797	86.7000	86.7000	86.7000	86.7000	88.6294	89.0975	86.7000 (216)
Fuel for water heating, kWh/month	209.2369	183.8294	191.6512	170.0549	166.1287	148.0073	139.6691	156.6973	157.5142	176.5278	188.7420	203.3133 (219)
Water heating fuel used												2091.3719 (219)
Annual totals kWh/year												
Space heating fuel - main system												3688.3232 (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)												454.4468 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 908 * 1.00) =									-588.2895			-588.2895 (233)
Total delivered energy for all uses												5720.8524 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3688.3232	3.4800	128.3536 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2091.3719	3.4800	72.7797 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	454.4468	13.1900	59.9415 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-588.2895	13.1900	-77.5954 (252)
Total energy cost			313.3720 (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] =	0.8480 (257)
SAP value		88.1698
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	3688.3232	0.2160	796.6778 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2091.3719	0.2160	451.7363 (264)
Space and water heating			1248.4141 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)

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Energy saving/generation technologies			
PV Unit	-588.2895	0.5190	-305.3223 (269)
Total kg/year			1217.8748 (272)
CO2 emissions per m2			11.0500 (273)
EI value			89.4848
EI rating			89 (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	$3.48 / 0.8816 = 3.947$, stars = 4
Water heating environmental impact	$0.216 / 0.8816 = 0.2450$, stars = 4

FULL SAP CALCULATION PRINTOUT

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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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.5100
Infiltration rate					0.3771 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3488 (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	0.3662	0.3401	0.3488	0.3313	0.3313	0.3226	0.3139	0.3052	0.2965	0.3226	0.3052	0.3226 (22b)
Effective ac	0.5671	0.5578	0.5608	0.5549	0.5549	0.5520	0.5493	0.5466	0.5439	0.5520	0.5466	0.5520 (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 FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	59.7788	(33)
E-WM-28					0.0000	0.0000	110.0000 (32)
GF Timber						9.0000	587.9700 (32c)
1F Timber						9.0000	578.7900 (32c)
2F Timber						9.0000	568.4400 (32c)
Internal Floor 1F						18.0000	702.5400 (32d)
Internal Floor 2F						18.0000	578.5200 (32d)
Internal Ceiling GF						18.0000	702.5400 (32e)
Internal Ceiling 1F						18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
Thermal mass parameter (TMP) = Cm / TFA in kJ/m²K 171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
Total fabric heat loss (33) + (36) = 67.7339 (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	49.3887	48.5842	48.8458	48.3293	48.3293	48.0809	47.8392	47.6042	47.3757	48.0809	47.6042	48.0809 (38)
Heat transfer coeff	117.1226	116.3181	116.5796	116.0631	116.0631	115.8148	115.5731	115.3380	115.1096	115.8148	115.3380	115.8148 (39)
Average = Sum(39)m / 12 =												115.9125 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0628	1.0555	1.0579	1.0532	1.0532	1.0510	1.0488	1.0466	1.0446	1.0510	1.0466	1.0510 (40)
HLP (average)												1.0518 (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												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Energy content (annual)	Total = Sum(45)m =											1590.3899 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
	Total per year (kWh/year) = Sum(64)m =											1846.2641 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	(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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	(71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082	(72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941	(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			
East					4.6800	25.1925	0.6200	0.7000	0.7700	35.4602 (76)			
South					2.9100	56.7559	0.6200	0.7000	0.7700	49.6737 (78)			
West					1.7600	25.1925	0.6200	0.7000	0.7700	13.3354 (80)			
West					5.8000	25.1925	0.6200	0.7000	0.7700	43.9464 (80)			
West					0.8600	34.0000	0.6300	0.7000	1.0000	11.6054 (82)			
Solar gains	154.0211	243.7979	380.4230	531.2792	603.2859	665.2600	630.5379	565.0658	457.0155	304.5589	188.5601	126.4240	(83)
Total gains	819.1622	903.6138	1014.0940	1124.4590	1154.7703	1179.7997	1123.8261	1067.9257	983.5017	871.7678	800.8928	773.1181	(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	44.8567	45.1670	45.0657	45.2662	45.2662	45.3633	45.4581	45.5508	45.6412	45.3633	45.5508	45.3633
alpha	3.9904	4.0111	4.0044	4.0177	4.0177	4.0242	4.0305	4.0367	4.0427	4.0242	4.0367	4.0242
util living area	0.9794	0.9690	0.9379	0.8629	0.7333	0.5344	0.3950	0.4137	0.6654	0.8850	0.9622	0.9825 (86)
MIT	19.7460	19.8978	20.2109	20.5771	20.8378	20.9655	20.9920	20.9907	20.9177	20.6049	20.1397	19.7307 (87)
Th 2	20.0313	20.0373	20.0354	20.0392	20.0392	20.0411	20.0429	20.0447	20.0464	20.0411	20.0447	20.0411 (88)
util rest of house	0.9747	0.9622	0.9241	0.8329	0.6776	0.4537	0.3009	0.3159	0.5869	0.8521	0.9523	0.9785 (89)
MIT 2	18.3805	18.6027	19.0467	19.5521	19.8820	20.0176	20.0396	20.0408	19.9813	19.6025	18.9587	18.3655 (90)
Living area fraction	fLA = Living area / (4) = 0.1436 (91)											
MIT	18.5766	18.7886	19.2138	19.6993	20.0192	20.1537	20.1764	20.1771	20.1157	19.7464	19.1282	18.5615 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.4266	18.6386	19.0638	19.5493	19.8692	20.0037	20.0264	20.0271	19.9657	19.5964	18.9782	18.4115 (93)

8. Space heating requirement

Utilisation	0.9639	0.9488	0.9065	0.8151	0.6668	0.4504	0.2993	0.3141	0.5797	0.8335	0.9374	0.9687	(94)
Useful gains	789.6076	857.3799	919.2816	916.5194	769.9805	531.3996	336.3338	335.3935	570.1344	726.6459	750.7748	748.9579	(95)

FULL SAP CALCULATION PRINTOUT

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

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	1584.2668	1551.5203	1406.3915	1166.3512	855.2904	544.7558	338.2077	337.6109	606.1365	949.2664	1277.7382	1553.2463 (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	591.2264	466.4623	362.4098	179.8789	63.4706	0.0000	0.0000	0.0000	0.0000	165.6297	379.4136	598.3906 (98)
Space heating												2806.8819 (98)
Space heating per m2											(98) / (4) =	25.4708 (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												3118.7577 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	591.2264	466.4623	362.4098	179.8789	63.4706	0.0000	0.0000	0.0000	0.0000	165.6297	379.4136	598.3906 (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)	656.9182	518.2914	402.6775	199.8655	70.5229	0.0000	0.0000	0.0000	0.0000	184.0330	421.5707	664.8785 (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	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (64)
Efficiency of water heater	89.1851	89.1178	88.9167	88.4646	87.6733	86.7000	86.7000	86.7000	86.7000	88.3662	88.9601	86.7000 (216)
(217)m	89.1851	89.1178	88.9167	88.4646	87.6733	86.7000	86.7000	86.7000	86.7000	88.3662	88.9601	89.2096 (217)
Fuel for water heating, kWh/month	209.4124	183.9709	191.8873	170.4339	166.7092	148.0073	139.6691	156.6973	157.5142	177.0536	189.0334	203.4970 (219)
Water heating fuel used												2093.8855 (219)
Annual totals kWh/year												
Space heating fuel - main system												3118.7577 (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)												454.4468 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.81 * 1031 * 1.00) =									-668.0993			-668.0993 (233)
Total delivered energy for all uses												5073.9907 (238)

10a. Fuel costs - using BEDF prices (442)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3118.7577	3.9200	122.2553 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2093.8855	3.9200	82.0803 (247)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	454.4468	16.9600	77.0742 (250)
Additional standing charges			88.0000 (251)
Energy saving/generation technologies			
PV Unit	-668.0993	16.9600	-113.3096 (252)
Total energy cost			268.8201 (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	3118.7577	0.2160	673.6517 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2093.8855	0.2160	452.2793 (264)
Space and water heating			1125.9309 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	0.5190	-346.7435 (269)
Total kg/year			1053.9703 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
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Space heating - main system 1	3118.7577	1.2200	3804.8843 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2093.8855	1.2200	2554.5403 (264)
Space and water heating			6359.4247 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	454.4468	3.0700	1395.1517 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	3.0700	-2051.0649 (269)
Primary energy kWh/year			5933.7615 (272)
Primary energy kWh/m2/year			53.8454 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 89

(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	+ 1.1	-£ 32	-199 kg (18.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£32	1.81 kg/m²	B 89 B 91
Total Savings	£32	1.81 kg/m²	

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 442 TEST (29 Apr 2019)
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	£90	£98	-£8
Mains gas	£292	£251	£41
Space heating	£223	£223	£0
Water heating	£82	£50	£32
Lighting	£77	£77	£0
Generated (PV)	-£113	-£113	£0
Total cost of fuels	£269	£236	£33
Total cost of uses	£269	£237	£32
Delivered energy	46 kWh/m²	37 kWh/m²	9 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.9 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	54 kWh/m²	44 kWh/m²	10 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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.5100
Infiltration rate					0.3771 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3488 (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	0.4447	0.4360	0.4273	0.3837	0.3749	0.3313	0.3313	0.3226	0.3488	0.3749	0.3924	0.4098 (22b)
Effective ac	0.5989	0.5950	0.5913	0.5736	0.5703	0.5549	0.5549	0.5520	0.5608	0.5703	0.5770	0.5840 (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 FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18913.4600 (34)
Thermal mass parameter (TMP) = Cm / TFA in kJ/m²K 171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.9551 (36)
Total fabric heat loss (33) + (36) = 67.7339 (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	52.1600	51.8256	51.4978	49.9582	49.6702	48.3293	48.3293	48.0809	48.8458	49.6702	50.2529	50.8621 (38)
Heat transfer coeff	119.8938	119.5594	119.2317	117.6921	117.4040	116.0631	116.0631	115.8148	116.5796	117.4040	117.9868	118.5960 (39)
Average = Sum(39)m / 12 =												117.6907 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0880	1.0849	1.0820	1.0680	1.0654	1.0532	1.0532	1.0510	1.0579	1.0654	1.0707	1.0762 (40)
HLP (average)												1.0680 (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												2.8160 (42)
Average daily hot water use (litres/day)												101.0805 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)
Energy content (annual)	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1590.3899 (45)
	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (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												1.1404 (H8)
Utilisation factor												0.5839 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												101.0805 (H14)
Volume ratio Veff/V												0.7420 (H15)
Solar storage volume factor												0.9403 (H16)
Solar input												-875.6211 (H17)
Solar input	-25.3913	-42.3707	-72.1622	-96.7116	-119.4790	-117.4669	-115.9145	-101.2751	-79.3187	-54.1653	-30.1177	-21.2482 (63)
Output from w/h	161.3734	121.5801	98.4576	54.0622	26.6805	10.8554	5.1786	34.5814	57.2461	102.2902	138.0466	160.2908 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (65)
Total per year (kWh/year) = Sum(64)m = 970.6431 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (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
East				4.6800	19.6403		0.6200		0.7000		0.7700		27.6450 (76)
South				2.9100	46.7521		0.6200		0.7000		0.7700		40.9182 (78)
West				1.7600	19.6403		0.6200		0.7000		0.7700		10.3964 (80)
West				5.8000	19.6403		0.6200		0.7000		0.7700		34.2609 (80)
West				0.8600	26.0000		0.6300		0.7000		1.0000		8.8747 (82)
Solar gains	122.0951	226.8840	351.0604	487.3923	582.4045	591.2092	564.7954	493.9277	399.3316	262.6371	149.9185	101.9830	(83)
Total gains	787.2363	886.7000	984.7314	1080.5721	1133.8889	1105.7489	1058.0836	996.7876	925.8178	829.8460	762.2511	748.6771	(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	43.8199	43.9425	44.0633	44.6397	44.7492	45.2662	45.2662	45.3633	45.0657	44.7492	44.5282	44.2995
alpha	3.9213	3.9295	3.9376	3.9760	3.9833	4.0177	4.0177	4.0242	4.0044	3.9833	3.9685	3.9533
util living area	0.9842	0.9738	0.9500	0.8922	0.7840	0.6202	0.4689	0.5136	0.7404	0.9194	0.9738	0.9869 (86)

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MIT	19.5881	19.7781	20.0860	20.4683	20.7653	20.9338	20.9831	20.9758	20.8622	20.4702	19.9630	19.5538 (87)
Th 2	20.0107	20.0132	20.0156	20.0271	20.0292	20.0392	20.0392	20.0411	20.0354	20.0292	20.0249	20.0203 (88)
util rest of house												
	0.9807	0.9680	0.9387	0.8677	0.7363	0.5435	0.3725	0.4153	0.6707	0.8958	0.9670	0.9839 (89)
MIT 2	18.1379	18.4138	18.8562	19.3974	19.7869	19.9877	20.0308	20.0279	19.9148	19.4131	18.6919	18.0948 (90)
Living area fraction									fLA = Living area / (4) =			0.1436 (91)
MIT	18.3461	18.6096	19.0328	19.5511	19.9274	20.1235	20.1675	20.1640	20.0508	19.5648	18.8743	18.3043 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1961	18.4596	18.8828	19.4011	19.7774	19.9735	20.0175	20.0140	19.9008	19.4148	18.7243	18.1543 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9714	0.9554	0.9218	0.8488	0.7224	0.5379	0.3703	0.4124	0.6598	0.8768	0.9544	0.9757	(94)
Useful gains	764.7158	847.1680	907.7501	917.2326	819.1445	594.7990	391.7962	411.0692	610.8565	727.5938	727.4631	730.4991	(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	1666.0596	1621.1818	1476.4175	1235.8990	948.3178	623.6695	396.6435	418.5564	676.2600	1034.8967	1371.5177	1654.9183	(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	670.5998	520.1373	423.0886	229.4398	96.1049	0.0000	0.0000	0.0000	0.0000	228.6333	463.7193	687.7679	(98)
Space heating												3319.4909	(98)
Space heating per m2												30.1224	(99)
												(98) / (4) =	

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													3688.3232 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.5998	520.1373	423.0886	229.4398	96.1049	0.0000	0.0000	0.0000	0.0000	228.6333	463.7193	687.7679	(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)	745.1109	577.9303	470.0984	254.9331	106.7832	0.0000	0.0000	0.0000	0.0000	254.0370	515.2437	764.1866	(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	161.3734	121.5801	98.4576	54.0622	26.6805	10.8554	5.1786	34.5814	57.2461	102.2902	138.0466	160.2908	(64)
Efficiency of water heater (217)m	89.3404	89.3556	89.3579	89.3515	89.2617	86.7000	86.7000	86.7000	86.7000	88.9534	89.2210	89.3572	(216)
Fuel for water heating, kWh/month	180.6275	136.0632	110.1834	60.5051	29.8902	12.5207	5.9730	39.8863	66.0278	114.9930	154.7245	179.3822	(219)
Water heating fuel used												1090.7768	(219)
Annual totals kWh/year													
Space heating fuel - main system												3688.3232	(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)												454.4468	(232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 0.81 * 908 * 1.00) =										-588.2895		-588.2895	(233)
Total delivered energy for all uses												4770.2573	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3688.3232	3.4800	128.3536	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1090.7768	3.4800	37.9590	(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	454.4468	13.1900	59.9415	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-588.2895	13.1900	-77.5954	(252)
Total energy cost			285.1463	(255)

11a. SAP rating - Individual heating systems

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.7717 (257)
SAP value		89.2354
SAP rating (Section 12)		89 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3688.3232	0.2160	796.6778 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1090.7768	0.2160	235.6078 (264)
Space and water heating			1032.2856 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-588.2895	0.5190	-305.3223 (269)
Total kg/year			1027.6962 (272)
CO2 emissions per m2			9.3300 (273)
EI value			91.1268
EI rating			91 (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	39.0300 (1b)	x 2.3100 (2b)	= 90.1593 (1b) - (3b)
First floor	39.0300 (1c)	x 2.5500 (2c)	= 99.5265 (1c) - (3c)
Second floor	32.1400 (1d)	x 2.3100 (2d)	= 74.2434 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	110.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 263.9292 (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) = 0.1516 (8)
Pressure test					Yes
Measured/design AP50					4.5100
Infiltration rate					0.3771 (18)
Number of sides sheltered					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3488 (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	0.3662	0.3401	0.3488	0.3313	0.3313	0.3226	0.3139	0.3052	0.2965	0.3226	0.3052	0.3226 (22b)
Effective ac	0.5671	0.5578	0.5608	0.5549	0.5549	0.5520	0.5493	0.5466	0.5439	0.5520	0.5466	0.5520 (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 FD			1.9600	0.9000	1.7640		(26)
Windows (Uw = 1.40)			9.3500	1.3258	12.3958		(27)
French Door (Uw = 1.40)			5.8000	1.3258	7.6894		(27)
Roof Light (Uw = 1.80)			0.8600	1.6791	1.4440		(27a)
Jet Floor Lo			39.0300	0.1600	6.2448	75.0000	2927.2500 (28a)
100mm Knauf Supafil	102.0200	16.0100	86.0100	0.2500	21.5025	60.0000	5160.6000 (29a)
Dormer Cheek	3.9200	1.1000	2.8200	0.3000	0.8460	9.0000	25.3800 (29a)
Wall to void	14.0000		14.0000	0.1200	1.6800	9.0000	126.0000 (29a)
External Plane Ceiling	17.0600		17.0600	0.1300	2.2178	9.0000	153.5400 (30)
Ceiling to Void	6.8900		6.8900	0.1200	0.8268	9.0000	62.0100 (30)
External Sloping Ceiling	17.3200	0.8600	16.4600	0.1600	2.6336	9.0000	148.1400 (30)
Dormer Flat Roof	1.7800		1.7800	0.3000	0.5340	9.0000	16.0200 (30)
Total net area of external elements Aum(A, m ²)			202.0200				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =				59.7788		(33)
E-WM-28			54.5200	0.0000	0.0000	110.0000	5997.2000 (32)
GF Timber			65.3300			9.0000	587.9700 (32c)
1F Timber			64.3100			9.0000	578.7900 (32c)
2F Timber			63.1600			9.0000	568.4400 (32c)
Internal Floor 1F			39.0300			18.0000	702.5400 (32d)
Internal Floor 2F			32.1400			18.0000	578.5200 (32d)
Internal Ceiling GF			39.0300			18.0000	702.5400 (32e)
Internal Ceiling 1F			32.1400			18.0000	578.5200 (32e)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =						18913.4600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							171.6285 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.9551 (36)
Total fabric heat loss	(33) + (36) =						67.7339 (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	49.3887	48.5842	48.8458	48.3293	48.3293	48.0809	47.8392	47.6042	47.3757	48.0809	47.6042	48.0809 (38)
Heat transfer coeff	117.1226	116.3181	116.5796	116.0631	116.0631	115.8148	115.5731	115.3380	115.1096	115.8148	115.3380	115.8148 (39)
Average = Sum(39)m / 12 =												115.9125 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0628	1.0555	1.0579	1.0532	1.0532	1.0510	1.0488	1.0466	1.0446	1.0510	1.0466	1.0510 (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												2.8160 (42)	
Average daily hot water use (litres/day)												101.0805 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.1886	107.1453	103.1021	99.0589	95.0157	90.9725	90.9725	95.0157	99.0589	103.1021	107.1453	111.1886 (44)	
Energy content	164.8894	144.2133	148.8152	129.7407	124.4893	107.4248	99.5449	114.2292	115.5935	134.7130	147.0498	159.6866 (45)	
Energy content (annual)											Total = Sum(45)m =	1590.3899 (45)	
Distribution loss	(46)m = 0.15 x (45)m												
	24.7334	21.6320	22.3223	19.4611	18.6734	16.1137	14.9317	17.1344	17.3390	20.2070	22.0575	23.9530 (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	21.8753	19.7375	21.8045	21.0330	21.6702	20.8975	21.5482	21.6273	20.9713	21.7425	21.1145	21.8524 (61)	
Total heat required for water heating calculated for each month	186.7647	163.9509	170.6198	150.7737	146.1595	128.3223	121.0931	135.8565	136.5648	156.4555	168.1643	181.5390 (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												1.2762 (H8)	
Utilisation factor												0.5432 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												101.0805 (H14)	
Volume ratio Veff/V												0.7420 (H15)	
Solar storage volume factor												0.9403 (H16)	
Solar input												-911.6246 (H17)	
Solar input	-29.7394	-42.2875	-72.6821	-98.0650	-115.1832	-123.0339	-120.4464	-107.8032	-84.4025	-58.3530	-35.1739	-24.4544 (63)	
												Solar input (sum of months) = Sum(63)m =	-911.6246 (63)
Output from w/h	157.0253	121.6633	97.9377	52.7087	30.9763	5.2884	0.6466	28.0533	52.1623	98.1025	132.9905	157.0845 (64)	
												Total per year (kWh/year) = Sum(64)m =	934.6395 (64)
Heat gains from water heating, kWh/month	60.2945	52.8853	54.9322	48.3970	46.8102	40.9431	38.4857	43.3880	43.6777	50.2277	54.1727	58.5589 (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	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613	168.9613 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.3316	57.1388	46.4684	35.1796	26.2971	22.2012	23.9891	31.1820	41.8524	53.1412	62.0236	66.1196 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	405.7359	409.9462	399.3364	376.7495	348.2377	321.4405	303.5384	299.3281	309.9378	332.5247	361.0366	387.8338 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121	54.7121 (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)	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408	-112.6408 (71)
Water heating gains (Table 5)	81.0411	78.6984	73.8336	67.2181	62.9170	56.8655	51.7281	58.3173	60.6634	67.5104	75.2399	78.7082 (72)
Total internal gains	665.1412	659.8159	633.6710	593.1798	551.4844	514.5397	493.2882	502.8599	526.4862	567.2089	612.3327	646.6941 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
East	4.6800	25.1925	0.6200	0.7000	0.7700	35.4602 (76)
South	2.9100	56.7559	0.6200	0.7000	0.7700	49.6737 (78)
West	1.7600	25.1925	0.6200	0.7000	0.7700	13.3354 (80)
West	5.8000	25.1925	0.6200	0.7000	0.7700	43.9464 (80)
West	0.8600	34.0000	0.6300	0.7000	1.0000	11.6054 (82)

Solar gains	154.0211	243.7979	380.4230	531.2792	603.2859	665.2600	630.5379	565.0658	457.0155	304.5589	188.5601	126.4240 (83)
Total gains	819.1622	903.6138	1014.0940	1124.4590	1154.7703	1179.7997	1123.8261	1067.9257	983.5017	871.7678	800.8928	773.1181 (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	44.8567	45.1670	45.0657	45.2662	45.2662	45.3633	45.4581	45.5508	45.6412	45.3633	45.5508	45.3633
alpha	3.9904	4.0111	4.0044	4.0177	4.0177	4.0242	4.0305	4.0367	4.0427	4.0242	4.0367	4.0242
util living area	0.9794	0.9690	0.9379	0.8629	0.7333	0.5344	0.3950	0.4137	0.6654	0.8850	0.9622	0.9825 (86)

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MIT	19.7460	19.8978	20.2109	20.5771	20.8378	20.9655	20.9920	20.9907	20.9177	20.6049	20.1397	19.7307 (87)
Th 2	20.0313	20.0373	20.0354	20.0392	20.0392	20.0411	20.0429	20.0447	20.0464	20.0411	20.0447	20.0411 (88)
util rest of house												
	0.9747	0.9622	0.9241	0.8329	0.6776	0.4537	0.3009	0.3159	0.5869	0.8521	0.9523	0.9785 (89)
MIT 2	18.3805	18.6027	19.0467	19.5521	19.8820	20.0176	20.0396	20.0408	19.9813	19.6025	18.9587	18.3655 (90)
Living area fraction									fLA = Living area / (4) =			0.1436 (91)
MIT	18.5766	18.7886	19.2138	19.6993	20.0192	20.1537	20.1764	20.1771	20.1157	19.7464	19.1282	18.5615 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.4266	18.6386	19.0638	19.5493	19.8692	20.0037	20.0264	20.0271	19.9657	19.5964	18.9782	18.4115 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9639	0.9488	0.9065	0.8151	0.6668	0.4504	0.2993	0.3141	0.5797	0.8335	0.9374	0.9687	(94)
Useful gains	789.6076	857.3799	919.2816	916.5194	769.9805	531.3996	336.3338	335.3935	570.1344	726.6459	750.7748	748.9579	(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													
	1584.2668	1551.5203	1406.3915	1166.3512	855.2904	544.7558	338.2077	337.6109	606.1365	949.2664	1277.7382	1553.2463	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	591.2264	466.4623	362.4098	179.8789	63.4706	0.0000	0.0000	0.0000	0.0000	165.6297	379.4136	598.3906	(98)
Space heating												2806.8819	(98)
Space heating per m2												25.4708	(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													3118.7577 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	591.2264	466.4623	362.4098	179.8789	63.4706	0.0000	0.0000	0.0000	0.0000	165.6297	379.4136	598.3906	(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)	656.9182	518.2914	402.6775	199.8655	70.5229	0.0000	0.0000	0.0000	0.0000	184.0330	421.5707	664.8785	(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	157.0253	121.6633	97.9377	52.7087	30.9763	5.2884	0.6466	28.0533	52.1623	98.1025	132.9905	157.0845	(64)
Efficiency of water heater													
(217)m	89.2868	89.2969	89.2771	89.2303	88.8903	86.7000	86.7000	86.7000	86.7000	88.7435	89.1196	89.2933	(216)
Fuel for water heating, kWh/month	175.8661	136.2459	109.7008	59.0704	34.8478	6.0997	0.7458	32.3567	60.1641	110.5461	149.2269	175.9197	(219)
Water heating fuel used												1050.7902	(219)
Annual totals kWh/year													
Space heating fuel - main system												3118.7577	(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)													454.4468 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 0.81 * 1031 * 1.00) =									-668.0993			-668.0993	(233)
Total delivered energy for all uses												4080.8953	(238)

10a. Fuel costs - using BEDF prices (442)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3118.7577	3.9200	122.2553	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1050.7902	3.9200	41.1910	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	454.4468	16.9600	77.0742	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-668.0993	16.9600	-113.3096	(252)
Total energy cost			236.4108	(255)

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3118.7577	0.2160	673.6517 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1050.7902	0.2160	226.9707 (264)
Space and water heating			900.6223 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	454.4468	0.5190	235.8579 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	0.5190	-346.7435 (269)
Total kg/year			854.6117 (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	3118.7577	1.2200	3804.8843 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1050.7902	1.2200	1281.9640 (264)
Space and water heating			5086.8484 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	454.4468	3.0700	1395.1517 (268)
Energy saving/generation technologies			
PV Unit	-668.0993	3.0700	-2051.0649 (269)
Primary energy kWh/year			4814.6852 (272)
Primary energy kWh/m2/year			43.6904 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	171.6 (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	348.39 (P1)
Transmission heat loss coefficient	67.73 (P7)
Summer heat loss coefficient	416.12 (P2)

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

Solar shading	Z_blinds	Solar access	Z_overhangs	Z_summer
Orientation				
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)
West	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.6800	125.2818	0.6200	0.7000	0.9000	206.1145
South	2.9100	118.5567	0.6200	0.7000	0.9000	121.2813
West	1.7600	125.2818	0.6200	0.7000	0.9000	77.5131
West	5.8000	125.2818	0.6200	0.7000	0.9000	255.4410
West	0.8600	217.0000	0.6300	0.7000	1.0000	74.0695
total:						734.4194

	Jun	Jul	Aug	
Solar gains	788	734	657	(P3)
Internal gains	512	490	500	
Total summer gains	1299	1225	1156	(P5)
Summer gain/loss ratio	3.12	2.94	2.78	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 171.6)	0.80	0.80	0.80	
Threshold temperature	19.32	21.04	20.88	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

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Assessment of likelihood of high internal temperature: Slight