

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	4907-0015-3990-026			Issued on Date	12/02/2020
Assessment Reference	026	Prop Type Ref	2FF Semi		
Property	Plot 026, 2 Bed, K, Ba, Welwyn Garden City				
SAP Rating	85 B	DER	15.71	TER	17.83
Environmental	89 B	% DER<TER	11.90		
CO₂ Emissions (t/year)	0.84	DFEE	34.94	TFEE	41.74
General Requirements Compliance	Pass	% DFEE<TFEE	16.30		
Assessor Details	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk			Assessor ID	4907-0015
Client	TW North Thames, Taylor Wimpey				

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 62 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) 17.83 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.71 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)41.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)34.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.33 (max. 2.00)	1.40 (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: 4.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% 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

Continuous extract system (decentralised)
Specific fan power: 0.1900 0.1800
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (East Anglia): Slight OK
Based on:
Overshading: Average
Windows facing South West: 5.45 m², No overhang
Windows facing North West: 2.52 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.08 W/m²K
Door U-value 1.08 W/m²K

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	62.0600 (1b)	2.3500 (2b)	145.8410 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	145.8410 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				0 * 10 =	0.0000 (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) =				0.0000 / (5) =	0.0000 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.2000	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1700 (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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			5.4500	1.3258	7.2254		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	30.2600	7.9700	22.2900	0.2500	5.5725	52.8000	1176.9120 (29a)
External Wall to Stairwell	13.4900	2.1200	11.3700	0.2000	2.2740	52.8000	600.3360 (29a)
Plane ceiling	52.0400		52.0400	0.0800	4.1632	9.0000	468.3600 (30)
Sloping ceiling	9.5600		9.5600	0.2000	1.9120	9.0000	86.0400 (30)
Dormer Roof	1.7100		1.7100	0.2000	0.3420	9.0000	15.3900 (30)
Total net area of external elements Aum(A, m2)			107.0600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.1196		(33)
E-WM-248			25.5800	0.0000	0.0000	110.0000	2813.8000 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11110.1380 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							179.0225 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5021 (36)
Total fabric heat loss						(33) + (36) =	33.6217 (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	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638 (38)
Average = Sum(39)m / 12 =	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295 (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												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Energy conte	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy content (annual)	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1300.1221 (45)
Water storage loss:	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812 (46)
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	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413 (61)
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (64)
Heat gains from water heating, kWh/month	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3616	15.4204	12.5407	9.4941	7.0970	5.9916	6.4741	8.4153	11.2950	14.3416	16.7387	17.8441 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962 (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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696 (71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584 (72)
Total internal gains	317.0233	315.0149	303.5045	285.1428	266.7231	248.9187	237.3498	242.8172	252.2658	270.8162	292.0404	307.7432 (73)

6. Solar gains

[Jan]			Area	Solar flux	g	Specific data	FF	Access	Gains			
			m ²	Table 6a	W/m ²	or Table 6b	or Table 6c	factor	W			
Southwest			5.4500	36.7938	0.4300		0.0000	0.7700	66.3943 (79)			
Northwest			2.5200	11.2829	0.4300		0.0000	0.7700	9.4142 (81)			
Solar gains	75.8085	132.2569	189.2655	248.4311	290.9708	294.4562	281.5611	248.9700	209.6205	148.4115	91.3705	64.5078 (83)
Total gains	392.8317	447.2718	492.7700	533.5739	557.6938	543.3749	518.9109	491.7872	461.8863	419.2277	383.4109	372.2509 (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)												
tau	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996
alpha	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666
util living area	0.9901	0.9812	0.9613	0.9110	0.8041	0.6372	0.4794	0.5242	0.7545	0.9321	0.9817	0.9922 (86)
MIT	19.8180	19.9920	20.2535	20.5639	20.8188	20.9528	20.9896	20.9845	20.8981	20.5696	20.1246	19.7658 (87)
Th 2	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425 (88)
util rest of house	0.9878	0.9770	0.9524	0.8902	0.7607	0.5657	0.3904	0.4332	0.6900	0.9119	0.9769	0.9904 (89)
MIT 2	18.5576	18.8095	19.1851	19.6195	19.9534	20.1053	20.1372	20.1339	20.0524	19.6357	19.0038	18.4818 (90)
Living area fraction										fLA = Living area / (4) =		0.3896 (91)
MIT	19.0487	19.2702	19.6014	19.9874	20.2906	20.4355	20.4693	20.4653	20.3819	19.9996	19.4405	18.9821 (92)
Temperature adjustment												0.0000
adjusted MIT	19.0487	19.2702	19.6014	19.9874	20.2906	20.4355	20.4693	20.4653	20.3819	19.9996	19.4405	18.9821 (93)

8. Space heating requirement

Utilisation	0.9840	0.9716	0.9456	0.8860	0.7688	0.5911	0.4249	0.4682	0.7092	0.9080	0.9718	0.9871 (94)
Useful gains	386.5439	434.5571	465.9697	472.7283	428.7475	321.1676	220.4780	230.2709	327.5817	380.6392	372.5811	367.4405 (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	850.7857	828.9531	755.7594	639.5847	495.5508	336.6260	223.2024	234.5089	362.3751	542.2176	711.8652	852.7116 (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	345.3959	265.0341	215.6036	120.1366	49.7016	0.0000	0.0000	0.0000	0.0000	120.2144	244.2846	361.0417 (98)
Space heating												1721.4124 (98)
Space heating per m ²												(98) / (4) = 27.7379 (99)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 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 %) 93.5000 (206)
 Efficiency of secondary/supplementary heating system, % 0.0000 (208)
 Space heating requirement 1841.0828 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	345.3959	265.0341	215.6036	120.1366	49.7016	0.0000	0.0000	0.0000	0.0000	120.2144	244.2846	361.0417	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	369.4074	283.4589	230.5921	128.4883	53.1568	0.0000	0.0000	0.0000	0.0000	128.5715	261.2670	386.1408	(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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)
Efficiency of water heater (217)m	89.5119	89.4182	89.2367	88.8749	88.2374	87.3000	87.3000	87.3000	87.3000	88.8457	89.3412	87.3000	(216)
Fuel for water heating, kWh/month	166.2857	146.0167	152.0193	134.5489	131.1400	116.0228	109.1391	122.9226	123.7028	139.6864	149.7369	161.4347	(219)
Water heating fuel used												1652.6558	(219)
Annual totals kWh/year													
Space heating fuel - main system												1841.0828	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 5.0830, total flow = 21.0000, SFP = 0.2420
 mechanical ventilation fans (SFP = 0.2420) 43.0666 (230a)
 central heating pump 30.0000 (230c)
 main heating flue fan 45.0000 (230e)
 Total electricity for the above, kWh/year 118.0666 (231)
 Electricity for lighting (calculated in Appendix L) 306.6114 (232)
 Total delivered energy for all uses 3918.4166 (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	1841.0828	0.2160	397.6739	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1652.6558	0.2160	356.9737	(264)
Space and water heating			754.6475	(265)
Pumps and fans	118.0666	0.5190	61.2765	(267)
Energy for lighting	306.6114	0.5190	159.1313	(268)
Total CO2, kg/year			975.0554	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.7100	(273)

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

	DER	TFA	N	EF	
Total Floor Area		62.0600			15.7100 ZC1
Assumed number of occupants		2.0392			62.0600 ZC2
CO2 emission factor in Table 12 for electricity displaced from grid		0.5190			2.0392 ZC3
CO2 emissions from appliances, equation (L14)		17.0069			2.7061 ZC4
CO2 emissions from cooking, equation (L16)		2.7061			35.4230 ZC5
Total CO2 emissions		0.0000			0.0000 ZC6
Residual CO2 emissions offset from biofuel CHP		0.0000			0.0000 ZC7
Additional allowable electricity generation, kWh/m²/year		0.0000			0.0000 ZC8
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000			35.4230 ZC8
Net CO2 emissions					

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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	62.0600 (1b)	2.3500 (2b)	145.8410 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	145.8410 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				2 * 10 =	20.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				20.0000 / (5) =	0.1371 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3871 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3291 (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 infiltr rate												
Effective ac	0.4196	0.4113	0.4031	0.3620	0.3537	0.3126	0.3126	0.3044	0.3291	0.3537	0.3702	0.3867 (22b)
Effective ac	0.5880	0.5846	0.5812	0.5655	0.5626	0.5489	0.5489	0.5463	0.5541	0.5626	0.5685	0.5747 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
TER Opaque door			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			7.9700	1.3258	10.5663		(27)					
External Wall	30.2600	7.9700	22.2900	0.1800	4.0122		(29a)					
External Wall to Stairwell	13.4900	2.1200	11.3700	0.1800	2.0466		(29a)					
Plane ceiling	52.0400		52.0400	0.1300	6.7652		(30)					
Sloping ceiling	9.5600		9.5600	0.1300	1.2428		(30)					
Dormer Roof	1.7100		1.7100	0.1300	0.2223		(30)					
Total net area of external elements Aum(A, m ²)			107.0600				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	26.9754	(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)							6.4810 (36)					
Total fabric heat loss						(33) + (36) =	33.4564 (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	28.2997	28.1352	27.9740	27.2167	27.0750	26.4154	26.4154	26.2933	26.6695	27.0750	27.3616	27.6613 (38)
Average = Sum(39)m / 12 =	61.7561	61.5916	61.4304	60.6731	60.5314	59.8718	59.8718	59.7497	60.1259	60.5314	60.8180	61.1177 (39)
												60.6724 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9951	0.9925	0.9899	0.9777	0.9754	0.9647	0.9647	0.9628	0.9688	0.9754	0.9800	0.9848 (40)
Days in month												0.9776 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Energy content (annual)												Total = Sum(45)m = 1300.1221 (45)
Distribution loss (46)m = 0.15 x (45)m	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	46.3192	40.3153	42.9505	39.9350	39.5818	36.6750	37.8975	39.5818	39.9350	42.9505	43.1950	46.3192	(61)										
Total heat required for water heating calculated for each month	181.1140	158.2078	164.6049	145.9963	141.3502	124.4933	119.2741	132.9627	134.4311	153.0766	163.4062	176.8608	(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	181.1140	158.2078	164.6049	145.9963	141.3502	124.4933	119.2741	132.9627	134.4311	153.0766	163.4062	176.8608	(64)										
Heat gains from water heating, kWh/month	56.3991	49.2781	51.1877	45.2491	43.7334	38.3683	36.5321	40.9446	41.4037	47.3545	50.7690	54.9849	(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	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3616	15.4204	12.5407	9.4941	7.0970	5.9916	6.4741	8.4153	11.2950	14.3416	16.7387	17.8441	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	75.8052	73.3305	68.8007	62.8460	58.7815	53.2894	49.1023	55.0330	57.5051	63.6486	70.5125	73.9044	(72)
Total internal gains	327.8662	325.2985	313.2316	294.3150	275.3372	256.9762	245.4129	251.4366	261.4459	280.5511	302.3284	318.5892	(73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
Southwest	5.4500	36.7938	0.6300	0.7000	0.7700	61.2835	(79)						
Northwest	2.5200	11.2829	0.6300	0.7000	0.7700	8.6895	(81)						
Solar gains	69.9730	122.0761	174.6964	229.3076	268.5728	271.7899	259.8874	229.8051	193.4846	136.9872	84.3371	59.5422	(83)
Total gains	397.8392	447.3746	487.9280	523.6227	543.9100	528.7660	505.3003	481.2417	454.9305	417.5384	386.6655	378.1314	(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	69.7862	69.9726	70.1562	71.0319	71.1981	71.9825	71.9825	72.1296	71.6783	71.1981	70.8626	70.5152		
alpha	5.6524	5.6648	5.6771	5.7355	5.7465	5.7988	5.7988	5.8086	5.7786	5.7465	5.7242	5.7010		
util living area	0.9972	0.9939	0.9849	0.9540	0.8660	0.6900	0.5156	0.5614	0.8105	0.9661	0.9938	0.9979	(86)	
MIT	20.0118	20.1478	20.3606	20.6335	20.8563	20.9713	20.9954	20.9927	20.9278	20.6465	20.2799	19.9867	(87)	
Th 2	20.0874	20.0896	20.0918	20.1020	20.1039	20.1128	20.1128	20.1145	20.1094	20.1039	20.1000	20.0960	(88)	
util rest of house	0.9963	0.9920	0.9798	0.9378	0.8218	0.6083	0.4147	0.4584	0.7396	0.9509	0.9914	0.9972	(89)	
MIT 2	18.7677	18.9674	19.2770	19.6705	19.9627	20.0935	20.1111	20.1114	20.0524	19.6958	19.1685	18.7375	(90)	
Living area fraction	19.2524	19.4273	19.6992	20.0457	20.3109	20.4355	20.4556	20.4548	fLA = Living area / (4) =	20.3935	20.0662	19.6015	0.3896	(91)
MIT	19.2524	19.4273	19.6992	20.0457	20.3109	20.4355	20.4556	20.4548	20.3935	20.0662	19.6015	19.2242	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.2524	19.4273	19.6992	20.0457	20.3109	20.4355	20.4556	20.4548	20.3935	20.0662	19.6015	19.2242	(93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9951	0.9900	0.9769	0.9366	0.8330	0.6392	0.4542	0.4987	0.7641	0.9501	0.9896	0.9963	(94)
Ext temp.	395.8913	442.9219	476.6780	490.4455	453.0988	337.9798	229.5028	240.0170	347.6076	396.6995	382.6616	376.7136	(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	923.4022	894.7611	810.8306	676.2414	521.2276	349.3826	230.8438	242.2714	378.4008	573.0042	760.3165	918.2462	(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	392.4681	303.6359	248.6095	133.7731	50.6879	0.0000	0.0000	0.0000	0.0000	131.1707	271.9115	402.9003	(98)
Space heating per m2												1935.1570	(98)
										(98) / (4) =		31.1820	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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													2071.9026 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	392.4681	303.6359	248.6095	133.7731	50.6879	0.0000	0.0000	0.0000	0.0000	131.1707	271.9115	402.9003	(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)	420.2014	325.0920	266.1772	143.2260	54.2697	0.0000	0.0000	0.0000	0.0000	140.4397	291.1258	431.3707	(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	181.1140	158.2078	164.6049	145.9963	141.3502	124.4933	119.2741	132.9627	134.4311	153.0766	163.4062	176.8608	(64)
Efficiency of water heater (217)m	86.9468	86.6659	86.0867	84.8319	82.7400	80.3000	80.3000	80.3000	80.3000	84.6651	86.3243	80.3000	(216)
Fuel for water heating, kWh/month	208.3043	182.5490	191.2083	172.1007	170.8366	155.0353	148.5356	165.5824	167.4111	180.8024	189.2934	203.1492	(219)
Water heating fuel used													2134.8081 (219)
Annual totals kWh/year													
Space heating fuel - main system													2071.9026 (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)													306.6114 (232)
Total delivered energy for all uses													4588.3221 (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	2071.9026	0.2160	447.5310 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2134.8081	0.2160	461.1186 (264)
Space and water heating			908.6495 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	306.6114	0.5190	159.1313 (268)
Total CO2, kg/m2/year			1106.7058 (272)
Emissions per m2 for space and water heating			14.6415 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.5642 (272b)
Emissions per m2 for pumps and fans			0.6272 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.6415 * 1.00) + 2.5642 + 0.6272, rounded to 2 d.p.			17.8300 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	62.0600 (1b)	x 2.3500 (2b)	= 145.8410 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 145.8410 (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					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
					Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					20.0000 / (5) = 0.1371 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3371 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2866 (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	0.3654	0.3582	0.3510	0.3152	0.3081	0.2722	0.2722	0.2651	0.2866	0.3081	0.3224	0.3367 (22b)
Effective ac	0.5667	0.5642	0.5616	0.5497	0.5474	0.5371	0.5371	0.5351	0.5411	0.5474	0.5520	0.5567 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			5.4500	1.3258	7.2254		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	30.2600	7.9700	22.2900	0.2500	5.5725	52.8000	1176.9120 (29a)
External Wall to Stairwell	13.4900	2.1200	11.3700	0.2000	2.2740	52.8000	600.3360 (29a)
Plane ceiling	52.0400		52.0400	0.0800	4.1632	9.0000	468.3600 (30)
Sloping ceiling	9.5600		9.5600	0.2000	1.9120	9.0000	86.0400 (30)
Dormer Roof	1.7100		1.7100	0.2000	0.3420	9.0000	15.3900 (30)
Total net area of external elements Aum(A, m2)			107.0600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.1196		(33)
E-WM-248			25.5800	0.0000	0.0000	110.0000	2813.8000 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11110.1380 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							179.0225 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5021 (36)
Total fabric heat loss						(33) + (36) =	33.6217 (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	27.2762	27.1514	27.0292	26.4549	26.3474	25.8472	25.8472	25.7546	26.0399	26.3474	26.5648	26.7920 (38)
Heat transfer coeff	60.8979	60.7731	60.6509	60.0766	59.9691	59.4689	59.4689	59.3763	59.6616	59.9691	60.1865	60.4137 (39)
Average = Sum(39)m / 12 =												60.0760 (39)
HLP	0.9813	0.9793	0.9773	0.9680	0.9663	0.9582	0.9582	0.9568	0.9614	0.9663	0.9698	0.9735 (40)
HLP (average)												0.9680 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Energy content (annual)										Total = Sum(45)m =		1300.1221 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	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	0.0000	(56)
If cylinder contains dedicated solar storage														
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Heat gains from water heating, kWh/month	28.6439	25.0521	25.8516	22.5380	21.6258	18.6614	17.2925	19.8434	20.0804	23.4018	25.5449	27.7401	27.7401	(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	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3616	15.4204	12.5407	9.4941	7.0970	5.9916	6.4741	8.4153	11.2950	14.3416	16.7387	17.8441	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	38.4999	37.2800	34.7467	31.3028	29.0669	25.9186	23.2426	26.6713	27.8895	31.4540	35.4790	37.2851	(72)
Total internal gains	287.5609	286.2480	276.1776	259.7718	242.6226	226.6054	216.5532	220.0748	228.8302	245.3566	264.2949	278.9699	(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							
Southwest	5.4500	36.7938	0.4300	0.0000	0.7700	66.3943 (79)							
Northwest	2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (81)							
Solar gains	75.8085	132.2569	189.2655	248.4311	290.9708	294.4562	281.5611	248.9700	209.6205	148.4115	91.3705	64.5078	(83)
Total gains	363.3693	418.5049	465.4431	508.2029	533.5934	521.0615	498.1143	469.0448	438.4507	393.7681	355.6654	343.4776	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	50.6774	50.7815	50.8838	51.3703	51.4623	51.8952	51.8952	51.9761	51.7276	51.4623	51.2765	51.0836	(85)
alpha	4.3785	4.3854	4.3923	4.4247	4.4308	4.4597	4.4597	4.4651	4.4485	4.4308	4.4184	4.4056	
util living area	0.9929	0.9860	0.9703	0.9279	0.8334	0.6713	0.5108	0.5594	0.7898	0.9476	0.9867	0.9944	(86)
MIT	19.6667	19.8499	20.1299	20.4795	20.7696	20.9370	20.9852	20.9780	20.8666	20.4891	20.0105	19.6292	(87)
Th 2	20.0990	20.1006	20.1023	20.1101	20.1115	20.1183	20.1183	20.1195	20.1157	20.1115	20.1086	20.1055	(88)
util rest of house	0.9912	0.9828	0.9630	0.9098	0.7922	0.5976	0.4149	0.4621	0.7268	0.9308	0.9831	0.9931	(89)
MIT 2	18.8759	19.0589	19.3361	19.6798	19.9449	20.0839	20.1130	20.1111	20.0335	19.6958	19.2257	18.8438	(90)
Living area fraction										fLA = Living area / (4) =		0.3896	(91)
MIT	19.1841	19.3671	19.6454	19.9914	20.2662	20.4163	20.4529	20.4489	20.3581	20.0049	19.5315	19.1498	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1841	19.3671	19.6454	19.9914	20.2662	20.4163	20.4529	20.4489	20.3581	20.0049	19.5315	19.1498	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9890	0.9794	0.9586	0.9070	0.8000	0.6236	0.4521	0.4996	0.7455	0.9284	0.9800	0.9912	(94)
Useful gains	359.3616	409.8900	446.1659	460.9639	426.8986	324.9517	225.1918	234.3227	326.8805	365.5725	348.5594	340.4532	(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	906.4072	879.2096	797.2780	666.3311	513.7079	345.8902	229.1248	240.4072	373.3665	564.0015	748.2084	903.1728	(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	407.0019	315.3828	261.2274	147.8644	64.5861	0.0000	0.0000	0.0000	0.0000	147.6312	287.7473	418.6634	(98)
Space heating												2050.1043	(98)
Space heating per m2												(98) / (4) =	33.0342 (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	559.0078	440.0699	451.2597	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8895	0.9379	0.9219	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	497.2281	412.7297	416.0000	0.0000	0.0000	0.0000	0.0000	(102)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	685.7334	657.4622	624.8917	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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	135.7238	182.0809	155.4154	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												473.2202 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	33.9310	45.5202	38.8539	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												118.3050 (107)
Space cooling per m2												1.9063 (108)
Energy for space heating												33.0342 (99)
Energy for space cooling												1.9063 (108)
Total												34.9405 (109)
Dwelling Fabric Energy Efficiency (DFEE)												34.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	62.0600 (1b)	2.3500 (2b)	145.8410 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	145.8410 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				2 * 10 =	20.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				20.0000 / (5) =	0.1371 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.3871 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3291 (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												
Effective ac	0.4196	0.4113	0.4031	0.3620	0.3537	0.3126	0.3126	0.3044	0.3291	0.3537	0.3702	0.3867 (22b)
	0.5880	0.5846	0.5812	0.5655	0.5626	0.5489	0.5489	0.5463	0.5541	0.5626	0.5685	0.5747 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			7.9700	1.3258	10.5663		(27)					
External Wall	30.2600	7.9700	22.2900	0.1800	4.0122		(29a)					
External Wall to Stairwell	13.4900	2.1200	11.3700	0.1800	2.0466		(29a)					
Plane ceiling	52.0400		52.0400	0.1300	6.7652		(30)					
Sloping ceiling	9.5600		9.5600	0.1300	1.2428		(30)					
Dormer Roof	1.7100		1.7100	0.1300	0.2223		(30)					
Total net area of external elements Aum(A, m2)			107.0600				(31)					
Fabric heat loss, W/K = Sum (A x U)					26.9754		(32)					
(26)...(30) + (32) =												
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.4810 (36)					
Total fabric heat loss							(33) + (36) = 33.4564 (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	28.2997	28.1352	27.9740	27.2167	27.0750	26.4154	26.4154	26.2933	26.6695	27.0750	27.3616	27.6613 (38)
Average = Sum(39)m / 12 =	61.7561	61.5916	61.4304	60.6731	60.5314	59.8718	59.8718	59.7497	60.1259	60.5314	60.8180	61.1177 (39)
	60.6724 (39)											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9951	0.9925	0.9899	0.9777	0.9754	0.9647	0.9647	0.9628	0.9688	0.9754	0.9800	0.9848 (40)
Days in month												0.9776 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Energy content (annual)												Total = Sum(45)m = 1300.1221 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	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	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	28.6439	25.0521	25.8516	22.5380	21.6258	18.6614	17.2925	19.8434	20.0804	23.4018	25.5449	27.7401	27.7401	25.5449	27.7401	(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	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3616	15.4204	12.5407	9.4941	7.0970	5.9916	6.4741	8.4153	11.2950	14.3416	16.7387	17.8441	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	38.4999	37.2800	34.7467	31.3028	29.0669	25.9186	23.2426	26.6713	27.8895	31.4540	35.4790	37.2851	(72)
Total internal gains	287.5609	286.2480	276.1776	259.7718	242.6226	226.6054	216.5532	220.0748	228.8302	245.3566	264.2949	278.9699	(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						
Southwest	5.4500	36.7938	0.6300	0.7000	0.7700	61.2835 (79)						
Northwest	2.5200	11.2829	0.6300	0.7000	0.7700	8.6895 (81)						
Solar gains	69.9730	122.0761	174.6964	229.3076	268.5728	271.7899	259.8874	229.8051	193.4846	136.9872	84.3371	59.5422 (83)
Total gains	357.5338	408.3242	450.8740	489.0795	511.1954	498.3953	476.4406	449.8799	422.3148	382.3438	348.6320	338.5120 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	69.7862	69.9726	70.1562	71.0319	71.1981	71.9825	71.9825	72.1296	71.6783	71.1981	70.8626	70.5152	
alpha	5.6524	5.6648	5.6771	5.7355	5.7465	5.7988	5.7988	5.8086	5.7786	5.7465	5.7242	5.7010	
util living area	0.9984	0.9961	0.9895	0.9653	0.8896	0.7223	0.5448	0.5969	0.8448	0.9768	0.9963	0.9988	(86)
MIT	19.9498	20.0887	20.3070	20.5906	20.8309	20.9637	20.9940	20.9901	20.9091	20.5998	20.2222	19.9255	(87)
Th 2	20.0874	20.0896	20.0918	20.1020	20.1039	20.1128	20.1128	20.1145	20.1094	20.1039	20.1000	20.0960	(88)
util rest of house	0.9978	0.9948	0.9859	0.9523	0.8497	0.6404	0.4393	0.4892	0.7787	0.9658	0.9948	0.9984	(89)
MIT 2	19.1247	19.2649	19.4832	19.7678	19.9877	20.0958	20.1112	20.1115	20.0586	19.7819	19.4070	19.1075	(90)
Living area fraction	fLA = Living area / (4) =												0.3896 (91)
MIT	19.4462	19.5859	19.8041	20.0884	20.3162	20.4340	20.4551	20.4538	20.3900	20.1006	19.7246	19.4262	(92)
Temperature adjustment													0.0000
adjusted MIT	19.4462	19.5859	19.8041	20.0884	20.3162	20.4340	20.4551	20.4538	20.3900	20.1006	19.7246	19.4262	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9939	0.9844	0.9521	0.8602	0.6715	0.4807	0.5315	0.8016	0.9657	0.9940	0.9980	(94)
Useful gains	356.5699	405.8371	443.8363	465.6518	439.7205	334.6874	229.0218	239.1038	338.5395	369.2356	346.5478	337.8361	(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	935.3693	904.5276	817.2787	678.8336	521.5520	349.2893	230.8146	242.2156	378.1888	575.0822	767.8041	930.5906	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	430.6267	335.1200	277.8411	153.4909	60.8826	0.0000	0.0000	0.0000	0.0000	153.1499	303.3045	441.0093	(98)
Space heating													2155.4251 (98)
Space heating per m2													(98) / (4) = 34.7313 (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	562.7951	443.0514	454.0975	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9113	0.9582	0.9442	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	512.8528	424.5235	428.7599	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	659.2404	632.1293	602.4912	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	105.3991	154.4588	129.2561	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													389.1140 (104)



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction												FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh													
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	26.3498	38.6147	32.3140	0.0000	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2													97.2785 (107)
Energy for space heating													1.5675 (108)
Energy for space cooling													34.7313 (99)
Total													1.5675 (108)
Target Fabric Energy Efficiency (TFEE)													36.2988 (109)
													41.7 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	62.0600 (1b)	2.3500 (2b)	145.8410 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	145.8410 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				0 * 10 =	0.0000 (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) =				0.0000 / (5) =	0.0000 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.2000	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1700 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.9000	4.8000	4.7000	4.2000	4.2000	3.7000	3.8000	3.8000	4.0000	4.2000	4.3000	4.5000 (22)
Wind factor	1.2250	1.2000	1.1750	1.0500	1.0500	0.9250	0.9500	0.9500	1.0000	1.0500	1.0750	1.1250 (22a)
Adj infilt rate	0.2083	0.2040	0.1998	0.1785	0.1785	0.1573	0.1615	0.1615	0.1700	0.1785	0.1828	0.1913 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			5.4500	1.3258	7.2254		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	30.2600	7.9700	22.2900	0.2500	5.5725	52.8000	1176.9120 (29a)
External Wall to Stairwell	13.4900	2.1200	11.3700	0.2000	2.2740	52.8000	600.3360 (29a)
Plane ceiling	52.0400		52.0400	0.0800	4.1632	9.0000	468.3600 (30)
Sloping ceiling	9.5600		9.5600	0.2000	1.9120	9.0000	86.0400 (30)
Dormer Roof	1.7100		1.7100	0.2000	0.3420	9.0000	15.3900 (30)
Total net area of external elements Aum(A, m2)			107.0600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.1196		(33)
E-WM-248			25.5800	0.0000	0.0000	110.0000	2813.8000 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11110.1380 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							179.0225 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5021 (36)
Total fabric heat loss						(33) + (36) =	33.6217 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638 (38)
Heat transfer coeff	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855 (39)
Average = Sum(39)m / 12 =												57.6855 (39)
HLP	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295 (40)
HLP (average)												0.9295 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy content (annual)	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1300.1221 (45)
Water storage loss:	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812 (46)
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	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413 (61)
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (64)
RHI water heating demand	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154 (65)
Heat gains from water heating, kWh/month												1465 (64)
												1465 (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	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	43.4040	38.5511	31.3518	23.7354	17.7425	14.9789	16.1853	21.0382	28.2374	35.8539	41.8468	44.6104 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.8370	268.5956	261.6441	246.8452	228.1643	210.6069	198.8775	196.1189	203.0704	217.8692	236.5502	254.1076 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747 (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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696 (71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584 (72)
Total internal gains	467.2628	463.2530	445.1290	417.3138	389.1336	363.8772	349.1614	356.6303	372.6924	400.6963	431.6809	454.8357 (73)

6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W					
Southwest		5.4500	40.9830	0.4300	0.0000	0.7700	73.9537 (79)					
Northwest		2.5200	12.9465	0.4300	0.0000	0.7700	10.8022 (81)					
Solar gains	84.7559	137.9009	194.3228	268.8049	304.4881	321.4019	304.1880	270.6055	228.3841	161.7971	104.6707	71.4167 (83)
Total gains	552.0187	601.1539	639.4518	686.1187	693.6217	685.2791	653.3494	627.2358	601.0765	562.4934	536.3516	526.2524 (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	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996
alpha	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666
util living area	0.9618	0.9435	0.9014	0.8063	0.6572	0.4632	0.2993	0.3116	0.5552	0.8139	0.9321	0.9676 (86)
MIT	20.1576	20.2917	20.5243	20.7733	20.9290	20.9885	20.9988	20.9986	20.9745	20.8025	20.4499	20.1130 (87)
Th 2	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425 (88)
util rest of house	0.9540	0.9326	0.8825	0.7720	0.6038	0.3956	0.2243	0.2336	0.4834	0.7729	0.9167	0.9609 (89)
MIT 2	19.0449	19.2342	19.5584	19.8886	20.0760	20.1350	20.1421	20.1420	20.1241	19.9328	19.4612	18.9818 (90)
Living area fraction	19.4784	19.6462	19.9347	20.2333	20.4084	20.4675	20.4759	20.4758	20.4555	20.2717	19.8464	19.4225 (91)
Temperature adjustment												0.0000 (92)
adjusted MIT	19.4784	19.6462	19.9347	20.2333	20.4084	20.4675	20.4759	20.4758	20.4555	20.2717	19.8464	19.4225 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9468	0.9251	0.8774	0.7759	0.6209	0.4215	0.2536	0.2640	0.5102	0.7796	0.9106	0.9540 (94)
Ext temp.	522.6664	556.1528	561.0444	532.3252	430.6770	288.8672	165.6617	165.6100	306.6741	438.4971	488.4004	502.0677 (95)
Heat loss rate W	4.7000	5.2000	7.0000	9.5000	12.5000	15.4000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000 (96)
Month fracti	852.5015	833.3377	746.1449	619.1530	456.1987	292.3223	165.8985	165.8912	314.7008	511.7666	700.6714	849.2743 (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	245.3973	186.2683	137.7148	62.5160	18.9882	0.0000	0.0000	0.0000	0.0000	54.5125	152.8351	258.3217 (98)
RHI space heating demand												1117 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	62.0600 (1b)	2.3500 (2b)	145.8410 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	145.8410 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				0 * 10 =	0.0000 (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) =				0.0000 / (5) =	0.0000 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.2000	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1700 (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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			5.4500	1.3258	7.2254		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	30.2600	7.9700	22.2900	0.2500	5.5725	52.8000	1176.9120 (29a)
External Wall to Stairwell	13.4900	2.1200	11.3700	0.2000	2.2740	52.8000	600.3360 (29a)
Plane ceiling	52.0400		52.0400	0.0800	4.1632	9.0000	468.3600 (30)
Sloping ceiling	9.5600		9.5600	0.2000	1.9120	9.0000	86.0400 (30)
Dormer Roof	1.7100		1.7100	0.2000	0.3420	9.0000	15.3900 (30)
Total net area of external elements Aum(A, m2)			107.0600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.1196		(33)
E-WM-248			25.5800	0.0000	0.0000	110.0000	2813.8000 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11110.1380 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							179.0225 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5021 (36)
Total fabric heat loss						(33) + (36) =	33.6217 (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	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638 (38)
Average = Sum(39)m / 12 =	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855 (39)
HLP	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295 (40)
HLP (average)												0.9295 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy content (annual)	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1300.1221 (45)
Water storage loss:	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812 (46)
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	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413 (61)
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (64)
Heat gains from water heating, kWh/month	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154 (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	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	43.4040	38.5511	31.3518	23.7354	17.7425	14.9789	16.1853	21.0382	28.2374	35.8539	41.8468	44.6104 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.8370	268.5956	261.6441	246.8452	228.1643	210.6069	198.8775	196.1189	203.0704	217.8692	236.5502	254.1076 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747 (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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696 (71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584 (72)
Total internal gains	467.2628	463.2530	445.1290	417.3138	389.1336	363.8772	349.1614	356.6303	372.6924	400.6963	431.6809	454.8357 (73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m ²	Table 6a	W/m ²	Specific data	factor	W						
			or Table 6b	or Table 6c	Table 6d							
Southwest	5.4500	36.7938	0.4300	0.0000	0.7700	66.3943 (79)						
Northwest	2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (81)						
Solar gains	75.8085	132.2569	189.2655	248.4311	290.9708	294.4562	281.5611	248.9700	209.6205	148.4115	91.3705	64.5078 (83)
Total gains	543.0712	595.5098	634.3945	665.7449	680.1044	658.3334	630.7225	605.6002	582.3129	549.1078	523.0514	519.3435 (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	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996
alpha	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666
util living area	0.9668	0.9485	0.9130	0.8392	0.7119	0.5425	0.3986	0.4324	0.6403	0.8547	0.9455	0.9723 (86)	
MIT	20.0980	20.2512	20.4706	20.7133	20.8923	20.9752	20.9951	20.9928	20.9482	20.7312	20.3677	20.0448 (87)	
Th 2	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425 (88)	
util rest of house	0.9601	0.9385	0.8963	0.8094	0.6637	0.4763	0.3227	0.3544	0.5741	0.8214	0.9332	0.9666 (89)	
MIT 2	18.9596	19.1769	19.4843	19.8120	20.0351	20.1238	20.1401	20.1387	20.0995	19.8428	19.3461	18.8837 (90)	
Living area fraction									fLA = Living area / (4) =			0.3896 (91)	
MIT	19.4032	19.5955	19.8686	20.1632	20.3691	20.4556	20.4732	20.4715	20.4302	20.1889	19.7441	19.3361 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.4032	19.5955	19.8686	20.1632	20.3691	20.4556	20.4732	20.4715	20.4302	20.1889	19.7441	19.3361 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9531	0.9310	0.8903	0.8102	0.6770	0.5009	0.3522	0.3847	0.5971	0.8233	0.9265	0.9600 (94)
Useful gains	517.6129	554.4349	564.7839	539.4025	460.4090	329.7763	222.1614	232.9548	347.6953	452.1064	484.6017	498.5680 (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	871.2335	847.7152	771.1754	649.7231	500.0801	337.7809	223.4272	234.8663	365.1595	553.1413	729.3831	873.1320 (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	263.0937	197.0844	153.5553	79.4309	29.5153	0.0000	0.0000	0.0000	0.0000	75.1700	176.2426	278.6756 (98)
Space heating												1252.7678 (98)
Space heating per m ²										(98) / (4) =		20.1864 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1339.8586 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	263.0937	197.0844	153.5553	79.4309	29.5153	0.0000	0.0000	0.0000	0.0000	75.1700	176.2426	278.6756	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	281.3837	210.7855	164.2303	84.9528	31.5671	0.0000	0.0000	0.0000	0.0000	80.3957	188.4947	298.0488	(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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)
Efficiency of water heater (217)m	89.3170	89.1971	88.9703	88.5497	87.9319	87.3000	87.3000	87.3000	87.3000	88.4802	89.0908	87.3000	(216)
Fuel for water heating, kWh/month	166.6485	146.3787	152.4746	135.0431	131.5957	116.0228	109.1391	122.9226	123.7028	140.2636	150.1577	161.7606	(219)
Water heating fuel used													1656.1095 (219)
Annual totals kWh/year													
Space heating fuel - main system													1339.8586 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.0830, total flow = 21.0000, SFP = 0.2420													
mechanical ventilation fans (SFP = 0.2420)													43.0666 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													118.0666 (231)
Electricity for lighting (calculated in Appendix L)													306.6114 (232)
Total delivered energy for all uses													3420.6461 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1339.8586	3.4800	46.6271 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1656.1095	3.4800	57.6326 (247)
Mechanical ventilation fans	43.0666	13.1900	5.6805 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	306.6114	13.1900	40.4420 (250)
Additional standing charges			120.0000 (251)
Total energy cost			280.2747 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.0995 (257)
SAP value		84.6616
SAP rating (Section 12)		85 (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	1339.8586	0.2160	289.4095 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1656.1095	0.2160	357.7196 (264)
Space and water heating			647.1291 (265)
Pumps and fans	118.0666	0.5190	61.2765 (267)
Energy for lighting	306.6114	0.5190	159.1313 (268)
Total kg/year			867.5370 (272)
CO2 emissions per m2			13.9800 (273)
EI value			89.1416
EI rating			89 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8834 = 3.939$, stars = 4
Water heating environmental impact	$0.216 / 0.8834 = 0.2445$, stars = 4

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	62.0600 (1b)	2.3500 (2b)	145.8410 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	145.8410 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour	
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)	
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)	
Number of intermittent fans				0 * 10 =	0.0000 (7a)	
Number of passive vents				0 * 10 =	0.0000 (7b)	
Number of flueless gas fires				0 * 40 =	0.0000 (7c)	
Air changes per hour						
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) =	0.0000 (8)
Pressure test					Yes	
Measured/design AP50					4.0000	
Infiltration rate					0.2000	(18)
Number of sides sheltered					2	(19)
Shelter factor					(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) =	0.1700 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.9000	4.8000	4.7000	4.2000	4.2000	3.7000	3.8000	3.8000	4.0000	4.2000	4.3000	4.5000 (22)
Wind factor	1.2250	1.2000	1.1750	1.0500	1.0500	0.9250	0.9500	0.9500	1.0000	1.0500	1.0750	1.1250 (22a)
Adj infilt rate	0.2083	0.2040	0.1998	0.1785	0.1785	0.1573	0.1615	0.1615	0.1700	0.1785	0.1828	0.1913 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			5.4500	1.3258	7.2254		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	30.2600	7.9700	22.2900	0.2500	5.5725	52.8000	1176.9120 (29a)
External Wall to Stairwell	13.4900	2.1200	11.3700	0.2000	2.2740	52.8000	600.3360 (29a)
Plane ceiling	52.0400		52.0400	0.0800	4.1632	9.0000	468.3600 (30)
Sloping ceiling	9.5600		9.5600	0.2000	1.9120	9.0000	86.0400 (30)
Dormer Roof	1.7100		1.7100	0.2000	0.3420	9.0000	15.3900 (30)
Total net area of external elements Aum(A, m2)			107.0600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	27.1196			(33)
E-WM-248			25.5800	0.0000	0.0000	110.0000	2813.8000 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	11110.1380			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K				179.0225			(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				6.5021			(36)
Total fabric heat loss			(33) + (36) =	33.6217			(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	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638	24.0638 (38)
Average = Sum(39)m / 12 =	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855	57.6855 (39)
HLP	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295	0.9295 (40)
HLP (average)												0.9295 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	31	28	31	30	31	30	31	31	30	31	30	31 (41)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy conte	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy content (annual)	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1300.1221 (45)
Water storage loss:	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812 (46)
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	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413 (61)
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829 (64)
Heat gains from water heating, kWh/month	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154 (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	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	43.4040	38.5511	31.3518	23.7354	17.7425	14.9789	16.1853	21.0382	28.2374	35.8539	41.8468	44.6104 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.8370	268.5956	261.6441	246.8452	228.1643	210.6069	198.8775	196.1189	203.0704	217.8692	236.5502	254.1076 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747 (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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696 (71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584 (72)
Total internal gains	467.2628	463.2530	445.1290	417.3138	389.1336	363.8772	349.1614	356.6303	372.6924	400.6963	431.6809	454.8357 (73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
Southwest	5.4500	40.9830	0.4300	0.0000	0.7700	73.9537 (79)						
Northwest	2.5200	12.9465	0.4300	0.0000	0.7700	10.8022 (81)						
Solar gains	84.7559	137.9009	194.3228	268.8049	304.4881	321.4019	304.1880	270.6055	228.3841	161.7971	104.6707	71.4167 (83)
Total gains	552.0187	601.1539	639.4518	686.1187	693.6217	685.2791	653.3494	627.2358	601.0765	562.4934	536.3516	526.2524 (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	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996	53.4996
alpha	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666	4.5666
util living area	0.9618	0.9435	0.9014	0.8063	0.6572	0.4632	0.2993	0.3116	0.5552	0.8139	0.9321	0.9676 (86)
MIT	20.1576	20.2917	20.5243	20.7733	20.9290	20.9885	20.9988	20.9986	20.9745	20.8025	20.4499	20.1130 (87)
Th 2	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425	20.1425 (88)
util rest of house	0.9540	0.9326	0.8825	0.7720	0.6038	0.3956	0.2243	0.2336	0.4834	0.7729	0.9167	0.9609 (89)
MIT 2	19.0449	19.2342	19.5584	19.8886	20.0760	20.1350	20.1421	20.1420	20.1241	19.9328	19.4612	18.9818 (90)
Living area fraction										fLA = Living area / (4) =		0.3896 (91)
MIT	19.4784	19.6462	19.9347	20.2333	20.4084	20.4675	20.4759	20.4758	20.4555	20.2717	19.8464	19.4225 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4784	19.6462	19.9347	20.2333	20.4084	20.4675	20.4759	20.4758	20.4555	20.2717	19.8464	19.4225 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9468	0.9251	0.8774	0.7759	0.6209	0.4215	0.2536	0.2640	0.5102	0.7796	0.9106	0.9540 (94)
Useful gains	522.6664	556.1528	561.0444	532.3252	430.6770	288.8672	165.6617	165.6100	306.6741	438.4971	488.4004	502.0677 (95)
Ext temp.	4.7000	5.2000	7.0000	9.5000	12.5000	15.4000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000 (96)
Heat loss rate W	852.5015	833.3377	746.1449	619.1530	456.1987	292.3223	165.8985	165.8912	314.7008	511.7666	700.6714	849.2743 (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	245.3973	186.2683	137.7148	62.5160	18.9882	0.0000	0.0000	0.0000	0.0000	54.5125	152.8351	258.3217 (98)
Space heating												1116.5539 (98)
Space heating per m2										(98) / (4) =		17.9915 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1194.1753 (211)
Space heating requirement	245.3973	186.2683	137.7148	62.5160	18.9882	0.0000	0.0000	0.0000	0.0000	54.5125	152.8351	258.3217	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	262.4570	199.2174	147.2886	66.8620	20.3082	0.0000	0.0000	0.0000	0.0000	58.3022	163.4600	276.2799	(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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)
Efficiency of water heater (217)m	89.2647	89.1533	88.8832	88.3728	87.7373	87.3000	87.3000	87.3000	87.3000	88.2524	88.9777	87.3000	(216)
Fuel for water heating, kWh/month	166.7462	146.4506	152.6239	135.3134	131.8876	116.0228	109.1391	122.9226	123.7028	140.6256	150.3486	161.8616	(219)
Water heating fuel used													1657.6448 (219)
Annual totals kWh/year													
Space heating fuel - main system													1194.1753 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 5.0830, total flow = 21.0000, SFP = 0.2420)													
mechanical ventilation fans (SFP = 0.2420)													43.0666 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													118.0666 (231)
Electricity for lighting (calculated in Appendix L)													306.6114 (232)
Total delivered energy for all uses													3276.4981 (238)

10a. Fuel costs - using BEDF prices (443)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1194.1753	3.9200	46.8117 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1657.6448	3.9200	64.9797 (247)
Mechanical ventilation fans	43.0666	16.9600	7.3041 (249)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	306.6114	16.9600	52.0013 (250)
Additional standing charges			88.0000 (251)
Total energy cost			271.8167 (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	1194.1753	0.2160	257.9419 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1657.6448	0.2160	358.0513 (264)
Space and water heating			615.9931 (265)
Pumps and fans	118.0666	0.5190	61.2765 (267)
Energy for lighting	306.6114	0.5190	159.1313 (268)
Total kg/year			836.4010 (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	1194.1753	1.2200	1456.8939 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1657.6448	1.2200	2022.3266 (264)
Space and water heating			3479.2205 (265)
Pumps and fans	118.0666	3.0700	362.4644 (267)
Energy for lighting	306.6114	3.0700	941.2971 (268)
Primary energy kWh/year			4782.9819 (272)
Primary energy kWh/m2/year			77.0703 (273)

SAP 2012 EPC IMPROVEMENTS

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Current energy efficiency rating: B 85
 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	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
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: (none) SAP change Cost change CO2 change

Recommended measures (none)	Typical annual savings	Energy efficiency	Environmental impact
	Total Savings £0		0.00 kg/m ²

Potential energy efficiency rating: B 85
 Potential environmental impact rating: B 89

Fuel prices for cost data on this page from database revision number 443 TEST (28 May 2019)
 Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, East Anglia):

	Current	Potential	Saving
Electricity	£72	£72	£0
Mains gas	£200	£200	£0
Space heating	£155	£155	£0
Water heating	£65	£65	£0
Lighting	£52	£52	£0
Total cost of fuels	£272	£272	£0
Total cost of uses	£272	£272	£0
Delivered energy	53 kWh/m ²	53 kWh/m ²	0 kWh/m ²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m ²	13 kg/m ²	13 kg/m ²	0 kg/m ²
Primary energy	77 kWh/m ²	77 kWh/m ²	0 kWh/m ²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

No improvements selected / applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Flat
Number of storeys	1
Cross ventilation possible	No
SAP Region	East Anglia
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	179.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	192.51 (P1)
Transmission heat loss coefficient	33.62 (37)
Summer heat loss coefficient	226.13 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South West	5.4500	122.3147	0.4300	0.0000	0.9000	257.9800
North West	2.5200	100.0415	0.4300	0.0000	0.9000	97.5644
total:						355.5444

	Jun	Jul	Aug
Solar gains	376	356	316 (P4)
Internal gains	361	346	354
Total summer gains	737	702	670 (P5)

	3.26	3.10	2.96
Summer gain/loss ratio			(P6)
Summer external temperature	15.40	17.60	17.60
Thermal mass temperature increment (TMP = 179.0)	0.75	0.75	0.75
Threshold temperature	19.40	21.45	21.31 (P7)
Likelihood of high internal temperature	Not significant	Slight	Slight

Assessment of likelihood of high internal temperature: Slight