

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property Reference	4907-0015-3990-005			Issued on Date	12/02/2020
Assessment Reference	005	Prop Type Ref	1FF Semi		
Property	Plot 005, 1 Bed, K, Ba, Welwyn Garden City				
SAP Rating	84 B	DER	16.78	TER	18.61
Environmental	90 B	% DER<TER	9.83		
CO <sub>2</sub> Emissions (t/year)	0.66	DFEE	36.63	TFEE	40.04
General Requirements Compliance	Pass	% DFEE<TFEE	8.51		
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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 46 m<sup>2</sup>

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) 18.61 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 16.78 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 40.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 36.6 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.34 (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 East: 2.00 m<sup>2</sup>, No overhang  
Windows facing South West: 3.99 m<sup>2</sup>, No overhang  
Windows facing North West: 3.79 m<sup>2</sup>, No overhang  
Air change rate: 6.00 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Door U-value 1.08 W/m<sup>2</sup>K

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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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	45.7400 (1b)	2.3900 (2b)	109.3186 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	45.7400		109.3186 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 109.3186 (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	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 m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			7.2600	1.3258	9.6250		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	44.8400	9.7800	35.0600	0.2500	8.7650	52.8000	1851.1680 (29a)
External Wall to Corridor	3.9900	2.1200	1.8700	0.2200	0.4114	52.8000	98.7360 (29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			48.8300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	24.4319		(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			45.7400			70.0000	3201.8000 (32d)
E-FC-4			45.7400			70.0000	3201.8000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			10593.0840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							231.5934 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3727 (36)
Total fabric heat loss						(33) + (36) =	28.8046 (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	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376 (38)
Average = Sum(39)m / 12 =	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422 (39)
HLP	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241 (40)
HLP (average)	1.0241 (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	1.5659 (42)											
Average daily hot water use (litres/day)	71.3891 (43)											
Daily hot water use	78.5281	75.6725	72.8169	69.9614	67.1058	64.2502	64.2502	67.1058	69.9614	72.8169	75.6725	78.5281 (44)
Energy conte	116.4548	101.8522	105.1023	91.6307	87.9219	75.8699	70.3046	80.6756	81.6391	95.1425	103.8555	112.7803 (45)

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1123.2292 (45)
Distribution loss (46)m = 0.15 x (45)m													
	17.4682	15.2778	15.7653	13.7446	13.1883	11.3805	10.5457	12.1013	12.2459	14.2714	15.5783	16.9170	(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	13.9760	12.6103	13.9402	13.4667	13.8982	13.4298	13.8650	13.8865	13.4499	13.9228	13.5014	13.9691	(61)
Total heat required for water heating calculated for each month													
Solar input	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(62)
	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	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(64)
Heat gains from water heating, kWh/month	42.2152	37.0184	38.4316	33.8339	32.7086	28.5842	26.8425	30.2962	30.5075	35.1156	37.9073	40.9917	(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	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.1609	10.8012	8.7841	6.6502	4.9711	4.1968	4.5348	5.8945	7.9115	10.0455	11.7246	12.4989	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	136.1901	137.6033	134.0420	126.4605	116.8901	107.8953	101.8863	100.4730	104.0343	111.6159	121.1862	130.1810	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	(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)	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	(71)
Water heating gains (Table 5)	56.7409	55.0869	51.6553	46.9915	43.9631	39.7003	36.0787	40.7208	42.3715	47.1984	52.6490	55.0964	(72)
Total internal gains	254.5798	252.9793	243.9694	229.5900	215.3122	201.2802	191.9876	196.5761	203.8052	218.3476	235.0477	247.2642	(73)

#### 6. Solar gains

[Jan]	Area	Solar flux	Specific data	Specific data	Access	Gains							
	m2	Table 6a	g	FF	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
Southeast	2.0000	36.7938	0.4300	0.0000	0.7700	24.3649 (77)							
Southwest	3.9900	36.7938	0.4300	0.0000	0.7700	48.6079 (79)							
Northwest	1.2700	11.2829	0.4300	0.0000	0.7700	4.7444 (81)							
Northwest	2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (81)							
Solar gains	87.1314	153.1200	221.9972	296.0034	350.6599	356.5306	340.2351	298.1738	247.4236	172.5983	105.2198	74.0121	(83)
Total gains	341.7112	406.0992	465.9666	525.5934	565.9721	557.8108	532.2227	494.7499	451.2289	390.9459	340.2675	321.2763	(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	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	
alpha	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	
util living area	0.9923	0.9810	0.9508	0.8683	0.7129	0.5273	0.3855	0.4322	0.6751	0.9152	0.9832	0.9943	(86)
MIT	20.0097	20.2050	20.4722	20.7533	20.9281	20.9874	20.9979	20.9963	20.9584	20.7109	20.2927	19.9553	(87)
Th 2	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	(88)
util rest of house	0.9900	0.9757	0.9374	0.8362	0.6570	0.4544	0.3044	0.3459	0.5984	0.8862	0.9776	0.9926	(89)
MIT 2	18.7539	19.0354	19.4136	19.7904	19.9981	20.0553	20.0625	20.0618	20.0328	19.7463	19.1646	18.6751	(90)
Living area fraction												FLA = Living area / (4) =	
MIT	19.3060	19.5496	19.8790	20.2137	20.4070	20.4651	20.4738	20.4727	20.4398	20.1704	19.6606	19.2380	(92)
Temperature adjustment													0.0000
adjusted MIT	19.3060	19.5496	19.8790	20.2137	20.4070	20.4651	20.4738	20.4727	20.4398	20.1704	19.6606	19.2380	(93)

#### 8. Space heating requirement

Utilisation	0.9877	0.9721	0.9344	0.8418	0.6783	0.4861	0.3401	0.3839	0.6304	0.8899	0.9745	0.9907	(94)
Useful gains	337.4993	394.7544	435.3954	442.4659	383.8750	271.1511	181.0060	189.9352	284.4394	347.9136	331.5999	318.2771	(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	702.9149	686.2213	626.7032	529.9594	407.8541	274.7332	181.4567	190.7729	296.9685	448.2999	588.3649	704.4112	(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	271.8692	195.8657	142.3330	62.9953	17.8404	0.0000	0.0000	0.0000	0.0000	74.6874	184.8708	287.2837	(98)
Space heating												1237.7456 (98)	
Space heating per m2												(98) / (4) = 27.0605 (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

	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													1323.7921 (211)
Space heating requirement	271.8692	195.8657	142.3330	62.9953	17.8404	0.0000	0.0000	0.0000	0.0000	74.6874	184.8708	287.2837	(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)	290.7692	209.4821	152.2278	67.3746	19.0807	0.0000	0.0000	0.0000	0.0000	79.8796	197.7228	307.2553	(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	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(64)
Efficiency of water heater (217)m	89.4371	89.2928	89.0140	88.4724	87.7627	87.3000	87.3000	87.3000	87.3000	88.5730	89.2300	87.3000	(216)
Fuel for water heating, kWh/month	145.8353	128.1878	133.7347	118.7912	116.0175	102.2906	96.4142	108.3185	108.9221	123.1361	131.5218	141.6262	(219)
Water heating fuel used													1454.7959 (219)
Annual totals kWh/year													
Space heating fuel - main system													1323.7921 (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)													32.2816 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													107.2816 (231)
Electricity for lighting (calculated in Appendix L)													214.7654 (232)
Total delivered energy for all uses													3100.6349 (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	1323.7921	0.2160	285.9391	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1454.7959	0.2160	314.2359	(264)
Space and water heating			600.1750	(265)
Pumps and fans	107.2816	0.5190	55.6791	(267)
Energy for lighting	214.7654	0.5190	111.4632	(268)
Total CO2, kg/year			767.3174	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.7800	(273)

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

DER			16.7800	ZC1
Total Floor Area		TFA	45.7400	
Assumed number of occupants		N	1.5659	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			17.6439	ZC2
CO2 emissions from cooking, equation (L16)			3.4233	ZC3
Total CO2 emissions			37.8472	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			37.8472	ZC8

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	45.7400 (1b)	2.3900 (2b)	109.3186 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	45.7400		109.3186 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 109.3186 (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) =	0.1830 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.4330 (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) =	0.3680 (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	0.4692	0.4600	0.4508	0.4048	0.3956	0.3496	0.3496	0.3404	0.3680	0.3956	0.4140	0.4324 (22b)
Effective ac	0.6101	0.6058	0.6016	0.5819	0.5783	0.5611	0.5611	0.5579	0.5677	0.5783	0.5857	0.5935 (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)			9.3100	1.3258	12.3428		(27)
External Wall	44.8400	9.3100	35.5300	0.1800	6.3954		(29a)
External Wall to Corridor	3.9900	2.1200	1.8700	0.1800	0.3366		(29a)
Total net area of external elements Aum(A, m2)			48.8300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 21.1948		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6030 (36)
Total fabric heat loss							(33) + (36) = 25.7978 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	22.0087	21.8545	21.7033	20.9934	20.8606	20.2422	20.2422	20.1277	20.4804	20.8606	21.1293	21.4102 (38)
Heat transfer coeff	47.8065	47.6523	47.5012	46.7912	46.6584	46.0400	46.0400	45.9255	46.2782	46.6584	46.9271	47.2080 (39)
Average = Sum(39)m / 12 =												46.7906 (39)
HLP	1.0452	1.0418	1.0385	1.0230	1.0201	1.0066	1.0066	1.0041	1.0118	1.0201	1.0260	1.0321 (40)
HLP (average)												1.0230 (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												1.5659 (42)
Average daily hot water use (litres/day)												71.3891 (43)
Daily hot water use	78.5281	75.6725	72.8169	69.9614	67.1058	64.2502	64.2502	67.1058	69.9614	72.8169	75.6725	78.5281 (44)
Energy conte	116.4548	101.8522	105.1023	91.6307	87.9219	75.8699	70.3046	80.6756	81.6391	95.1425	103.8555	112.7803 (45)
Energy content (annual)												Total = Sum(45)m = 1123.2292 (45)
Distribution loss (46)m = 0.15 x (45)m	17.4682	15.2778	15.7653	13.7446	13.1883	11.3805	10.5457	12.1013	12.2459	14.2714	15.5783	16.9170 (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												
Combi loss	40.0170	34.8301	37.1067	34.5015	34.1964	31.6850	32.7412	34.1964	34.5015	37.1067	37.3179	40.0170 (61)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month	156.4719	136.6822	142.2090	126.1322	122.1182	107.5549	103.0458	114.8719	116.1406	132.2492	141.1734	152.7973 (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	156.4719	136.6822	142.2090	126.1322	122.1182	107.5549	103.0458	114.8719	116.1406	132.2492	141.1734	152.7973 (64)
Heat gains from water heating, kWh/month	48.7255	42.5734	44.2232	39.0926	37.7831	33.1480	31.5616	35.3737	35.7704	40.9116	43.8614	47.5037 (65)
	Total per year (kWh/year) = Sum(64)m = 1551.4468 (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	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.2058	10.8411	8.8166	6.6747	4.9894	4.2123	4.5515	5.9162	7.9408	10.0826	11.7679	12.5451 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	136.1901	137.6033	134.0420	126.4605	116.8901	107.8953	101.8863	100.4730	104.0343	111.6159	121.1862	130.1810 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293 (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)	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344 (71)
Water heating gains (Table 5)	65.4913	63.3532	59.4398	54.2953	50.7838	46.0389	42.4215	47.5453	49.6811	54.9886	60.9186	63.8491 (72)
Total internal gains	263.3750	261.2855	251.7863	236.9183	222.1512	207.6344	198.3471	203.4225	211.1440	226.1750	243.3607	256.0630 (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	
Southeast	1.9000	36.7938	0.6300	0.7000	0.7700	21.3649 (77)
Southwest	3.8000	36.7938	0.6300	0.7000	0.7700	42.7298 (79)
Northwest	3.6100	11.2829	0.6300	0.7000	0.7700	12.4481 (81)

Solar gains	76.5427	134.5153	195.0323	260.0629	308.0946	313.2575	298.9379	261.9742	217.3749	151.6292	92.4335	65.0174 (83)
Total gains	339.9177	395.8008	446.8185	496.9813	530.2458	520.8919	497.2851	465.3967	428.5189	377.8042	335.7942	321.0804 (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	66.4426	66.6576	66.8697	67.8843	68.0776	68.9919	68.9919	69.1639	68.6368	68.0776	67.6877	67.2850
alpha	5.4295	5.4438	5.4580	5.5256	5.5385	5.5995	5.5995	5.6109	5.5758	5.5385	5.5125	5.4857
util living area	0.9944	0.9866	0.9647	0.8962	0.7513	0.5553	0.4058	0.4510	0.7021	0.9313	0.9873	0.9958 (86)
MIT	20.0364	20.2110	20.4599	20.7461	20.9252	20.9886	20.9983	20.9971	20.9611	20.7194	20.3262	20.0067 (87)
Th 2	20.0459	20.0486	20.0514	20.0642	20.0666	20.0779	20.0779	20.0800	20.0735	20.0666	20.0618	20.0567 (88)
util rest of house	0.9926	0.9825	0.9539	0.8671	0.6950	0.4798	0.3216	0.3624	0.6241	0.9049	0.9827	0.9945 (89)
MIT 2	18.7725	19.0271	19.3838	19.7826	19.9994	20.0709	20.0773	20.0788	20.0457	19.7591	19.2056	18.7374 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.3282	19.5476	19.8569	20.2062	20.4064	20.4744	20.4822	20.4825	20.4482	20.1813	19.6983	19.2955 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.3282	19.5476	19.8569	20.2062	20.4064	20.4744	20.4822	20.4825	20.4482	20.1813	19.6983	19.2955 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9909	0.9797	0.9513	0.8719	0.7164	0.5128	0.3587	0.4014	0.6569	0.9086	0.9804	0.9930 (94)
Useful gains	336.8137	387.7829	425.0629	433.3316	379.8914	267.0999	178.3658	186.8096	281.4993	343.2735	329.2114	318.8437 (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	718.4445	697.9921	634.4697	529.0317	406.2283	270.4568	178.7381	187.4931	293.7826	447.0493	591.2001	712.6288 (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	283.9333	208.4606	155.7987	68.9041	19.5947	0.0000	0.0000	0.0000	0.0000	77.2092	188.6319	292.9761 (98)
Space heating	1295.5086 (98)											
Space heating per m2	(98) / (4) = 28.3233 (99)											

#### 8c. Space cooling requirement

Not applicable

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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													1387.0542 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	283.9333	208.4606	155.7987	68.9041	19.5947	0.0000	0.0000	0.0000	0.0000	77.2092	188.6319	292.9761	(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)	303.9972	223.1912	166.8080	73.7731	20.9793	0.0000	0.0000	0.0000	0.0000	82.6651	201.9613	313.6789	(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	156.4719	136.6822	142.2090	126.1322	122.1182	107.5549	103.0458	114.8719	116.1406	132.2492	141.1734	152.7973	(64)
Efficiency of water heater (217)m	86.5330	86.1108	85.2813	83.5998	81.5600	80.3000	80.3000	80.3000	80.3000	83.7491	85.7816	86.6637	(217)
Fuel for water heating, kWh/month	180.8233	158.7283	166.7529	150.8762	149.7282	133.9414	128.3260	143.0535	144.6333	157.9112	164.5731	176.3107	(219)
Water heating fuel used													1855.6582 (219)
Annual totals kWh/year													
Space heating fuel - main system													1387.0542 (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)													215.5588 (232)
Total delivered energy for all uses													3533.2711 (238)

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 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	1387.0542	0.2160	299.6037 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1855.6582	0.2160	400.8222 (264)
Space and water heating			700.4259 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	215.5588	0.5190	111.8750 (268)
Total CO2, kg/m2/year			851.2259 (272)
Emissions per m2 for space and water heating			15.3132 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.4459 (272b)
Emissions per m2 for pumps and fans			0.8510 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.3132 * 1.00) + 2.4459 + 0.8510, rounded to 2 d.p.			18.6100 (273)

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# 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	45.7400 (1b)	2.3900 (2b)	109.3186 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	45.7400		109.3186 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 109.3186 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				20.0000 / (5) =	0.1830 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3830 (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) =	0.3255 (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	0.4150	0.4069	0.3987	0.3581	0.3499	0.3092	0.3092	0.3011	0.3255	0.3499	0.3662	0.3825 (22b)
Effective ac	0.5861	0.5828	0.5795	0.5641	0.5612	0.5478	0.5478	0.5453	0.5530	0.5612	0.5671	0.5731 (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)			7.2600	1.3258	9.6250		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	44.8400	9.7800	35.0600	0.2500	8.7650	52.8000	1851.1680 (29a)
External Wall to Corridor	3.9900	2.1200	1.8700	0.2200	0.4114	52.8000	98.7360 (29a)
Total net area of external elements Aum(A, m2)			48.8300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	24.4319		(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			45.7400			70.0000	3201.8000 (32d)
E-FC-4			45.7400			30.0000	1372.2000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	8763.4840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		191.5934 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.3727 (36)
Total fabric heat loss	(33) + (36) =	28.8046 (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	21.1444	21.0238	20.9055	20.3501	20.2462	19.7624	19.7624	19.6728	19.9488	20.2462	20.4564	20.6762 (38)
Heat transfer coeff	49.9491	49.8284	49.7102	49.1547	49.0508	48.5671	48.5671	48.4775	48.7534	49.0508	49.2611	49.4808 (39)
Average = Sum(39)m / 12 =												49.1542 (39)
HLP	1.0920	1.0894	1.0868	1.0747	1.0724	1.0618	1.0618	1.0598	1.0659	1.0724	1.0770	1.0818 (40)
HLP (average)												1.0746 (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												1.5659 (42)
Average daily hot water use (litres/day)												71.3891 (43)
Daily hot water use	78.5281	75.6725	72.8169	69.9614	67.1058	64.2502	64.2502	67.1058	69.9614	72.8169	75.6725	78.5281 (44)
Energy conte	116.4548	101.8522	105.1023	91.6307	87.9219	75.8699	70.3046	80.6756	81.6391	95.1425	103.8555	112.7803 (45)
Energy content (annual)										Total = Sum(45)m =		1123.2292 (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)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	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 (59)
Heat gains from water heating, kWh/month	24.7467	21.6436	22.3342	19.4715	18.6834	16.1224	14.9397	17.1436	17.3483	20.2178	22.0693	23.9658	(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	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.1609	10.8012	8.7841	6.6502	4.9711	4.1968	4.5348	5.8945	7.9115	10.0455	11.7246	12.4989	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	136.1901	137.6033	134.0420	126.4605	116.8901	107.8953	101.8863	100.4730	104.0343	111.6159	121.1862	130.1810	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	(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)	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	(71)
Water heating gains (Table 5)	33.2616	32.2077	30.0191	27.0438	25.1121	22.3922	20.0803	23.0424	24.0949	27.1744	30.6518	32.2121	(72)
Total internal gains	228.1005	227.1001	219.3332	206.6423	193.4611	180.9721	172.9892	175.8978	182.5286	195.3237	210.0505	221.3799	(73)

#### 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W				
Southeast		2.0000	36.7938	0.4300		0.0000	0.7700		24.3649	(77)			
Southwest		3.9900	36.7938	0.4300		0.0000	0.7700		48.6079	(79)			
Northwest		1.2700	11.2829	0.4300		0.0000	0.7700		4.7444	(81)			
Northwest		2.5200	11.2829	0.4300		0.0000	0.7700		9.4142	(81)			
Solar gains	87.1314	153.1200	221.9972	296.0034	350.6599	356.5306	340.2351	298.1738	247.4236	172.5983	105.2198	74.0121	(83)
Total gains	315.2319	380.2200	441.3304	502.6457	544.1211	537.5027	513.2243	474.0716	429.9523	367.9220	315.2703	295.3920	(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	48.7357	48.8536	48.9699	49.5232	49.6281	50.1225	50.1225	50.2151	49.9309	49.6281	49.4163	49.1968		
alpha	4.2490	4.2569	4.2647	4.3015	4.3085	4.3415	4.3415	4.3477	4.3287	4.3085	4.2944	4.2798		
util living area	0.9900	0.9776	0.9482	0.8728	0.7341	0.5544	0.4109	0.4608	0.7017	0.9172	0.9804	0.9923		(86)
MIT	19.6680	19.9009	20.2278	20.6002	20.8545	20.9670	20.9928	20.9884	20.9110	20.5575	20.0383	19.6237		(87)
Th 2	20.0074	20.0095	20.0116	20.0216	20.0235	20.0321	20.0321	20.0338	20.0288	20.0235	20.0197	20.0157		(88)
util rest of house	0.9875	0.9722	0.9358	0.8438	0.6809	0.4792	0.3231	0.3684	0.6274	0.8913	0.9747	0.9903		(89)
MIT 2	18.7998	19.0312	19.3508	19.7077	19.9266	20.0161	20.0299	20.0299	19.9792	19.6793	19.1770	18.7625		(90)
Living area fraction										fLA = Living area / (4) =		0.4397		(91)
MIT	19.1815	19.4136	19.7364	20.1001	20.3346	20.4342	20.4533	20.4513	20.3889	20.0654	19.5557	19.1412		(92)
Temperature adjustment												0.0000		
adjusted MIT	19.1815	19.4136	19.7364	20.1001	20.3346	20.4342	20.4533	20.4513	20.3889	20.0654	19.5557	19.1412		(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9848	0.9682	0.9317	0.8463	0.6987	0.5112	0.3617	0.4090	0.6564	0.8926	0.9713	0.9881	(94)
Useful gains	310.4360	368.1283	411.1880	425.4139	380.1723	274.7521	185.6458	193.8796	282.2278	328.3978	306.2221	291.8672	(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	743.3171	723.1877	657.9828	550.5371	423.5327	283.3478	187.1421	196.3964	306.6044	464.2845	613.5799	739.3009	(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	322.0635	238.5999	183.6153	90.0887	32.2601	0.0000	0.0000	0.0000	0.0000	101.0997	221.2976	332.8907	(98)
Space heating												1521.9156	(98)
Space heating per m2										(98) / (4) =		33.2732	(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	456.5303	359.3962	368.4288	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9361	0.9659	0.9534	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	427.3745	347.1309	351.2773	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	687.9241	658.4419	613.5313	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	187.5957	231.6154	195.1170	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												614.3281 (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	46.8989	57.9038	48.7793	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												153.5820 (107)
Space cooling per m2												3.3577 (108)
Energy for space heating												33.2732 (99)
Energy for space cooling												3.3577 (108)
Total												36.6309 (109)
Dwelling Fabric Energy Efficiency (DFEE)												36.6 (109)

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# 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	45.7400 (1b)	2.3900 (2b)	109.3186 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	45.7400		109.3186 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 109.3186 (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) =	0.1830 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.4330 (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) =	0.3680 (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	0.4692	0.4600	0.4508	0.4048	0.3956	0.3496	0.3496	0.3404	0.3680	0.3956	0.4140	0.4324 (22b)
Effective ac	0.6101	0.6058	0.6016	0.5819	0.5783	0.5611	0.5611	0.5579	0.5677	0.5783	0.5857	0.5935 (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)			9.3100	1.3258	12.3428		(27)
External Wall	44.8400	9.3100	35.5300	0.1800	6.3954		(29a)
External Wall to Corridor	3.9900	2.1200	1.8700	0.1800	0.3366		(29a)
Total net area of external elements Aum(A, m2)			48.8300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 21.1948		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6030 (36)
Total fabric heat loss							(33) + (36) = 25.7978 (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	22.0087	21.8545	21.7033	20.9934	20.8606	20.2422	20.2422	20.1277	20.4804	20.8606	21.1293	21.4102 (38)
Heat transfer coeff	47.8065	47.6523	47.5012	46.7912	46.6584	46.0400	46.0400	45.9255	46.2782	46.6584	46.9271	47.2080 (39)
Average = Sum(39)m / 12 =												46.7906 (39)
HLP	1.0452	1.0418	1.0385	1.0230	1.0201	1.0066	1.0066	1.0041	1.0118	1.0201	1.0260	1.0321 (40)
HLP (average)												1.0230 (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												1.5659 (42)
Average daily hot water use (litres/day)												71.3891 (43)
Daily hot water use	78.5281	75.6725	72.8169	69.9614	67.1058	64.2502	64.2502	67.1058	69.9614	72.8169	75.6725	78.5281 (44)
Energy conte	116.4548	101.8522	105.1023	91.6307	87.9219	75.8699	70.3046	80.6756	81.6391	95.1425	103.8555	112.7803 (45)
Energy content (annual)										Total = Sum(45)m =		1123.2292 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
												0.0000 (59)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month  
 24.7467 21.6436 22.3342 19.4715 18.6834 16.1224 14.9397 17.1436 17.3483 20.2178 22.0693 23.9658 (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	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929	78.2929 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.2058	10.8411	8.8166	6.6747	4.9894	4.2123	4.5515	5.9162	7.9408	10.0826	11.7679	12.5451 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	136.1901	137.6033	134.0420	126.4605	116.8901	107.8953	101.8863	100.4730	104.0343	111.6159	121.1862	130.1810 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293	30.8293 (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)	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344 (71)
Water heating gains (Table 5)	33.2616	32.2077	30.0191	27.0438	25.1121	22.3922	20.0803	23.0424	24.0949	27.1744	30.6518	32.2121 (72)
Total internal gains	228.1454	227.1400	219.3656	206.6669	193.4795	180.9876	173.0059	175.9196	182.5578	195.3608	210.0938	221.4261 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Southeast	1.9000	36.7938	0.6300	0.7000	0.7700	21.3649 (77)						
Southwest	3.8000	36.7938	0.6300	0.7000	0.7700	42.7298 (79)						
Northwest	3.6100	11.2829	0.6300	0.7000	0.7700	12.4481 (81)						
Solar gains	76.5427	134.5153	195.0323	260.0629	308.0946	313.2575	298.9379	261.9742	217.3749	151.6292	92.4335	65.0174 (83)
Total gains	304.6881	361.6553	414.3979	466.7298	501.5741	494.2451	471.9439	437.8938	399.9327	346.9900	302.5273	286.4434 (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)	66.4426	66.6576	66.8697	67.8843	68.0776	68.9919	68.9919	69.1639	68.6368	68.0776	67.6877	67.2850
tau	5.4295	5.4438	5.4580	5.5256	5.5385	5.5995	5.5995	5.6109	5.5758	5.5385	5.5125	5.4857
util living area	0.9967	0.9911	0.9741	0.9157	0.7797	0.5824	0.4271	0.4782	0.7390	0.9499	0.9922	0.9976 (86)
MIT	19.9645	20.1438	20.4025	20.7083	20.9099	20.9857	20.9979	20.9961	20.9500	20.6727	20.2603	19.9354 (87)
Th 2	20.0459	20.0486	20.0514	20.0642	20.0666	20.0779	20.0779	20.0800	20.0735	20.0666	20.0618	20.0567 (88)
util rest of house	0.9956	0.9883	0.9658	0.8902	0.7249	0.5044	0.3388	0.3848	0.6614	0.9290	0.9892	0.9968 (89)
MIT 2	19.1051	19.2853	19.5411	19.8395	20.0103	20.0718	20.0773	20.0789	20.0484	19.8157	19.4126	19.0851 (90)
Living area fraction	19.4830	19.6628	19.9198	20.2215	20.4058	20.4736	20.4821	20.4822	20.4448	20.1925	19.7853	19.4590 (92)
MIT	19.4830	19.6628	19.9198	20.2215	20.4058	20.4736	20.4821	20.4822	20.4448	20.1925	19.7853	19.4590 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4830	19.6628	19.9198	20.2215	20.4058	20.4736	20.4821	20.4822	20.4448	20.1925	19.7853	19.4590 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9948	0.9948	0.9868	0.9644	0.8949	0.7458	0.5385	0.3777	0.4260	0.6941	0.9323	0.9881	0.9962 (94)
Useful gains	303.0950	356.8929	399.6631	417.6970	374.0968	266.1572	178.2458	186.5536	277.5865	323.5004	298.9181	285.3445 (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	725.8448	703.4792	637.4572	529.7448	406.1983	270.4198	178.7299	187.4754	293.6248	447.5692	595.2849	720.3449 (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	314.5258	232.9060	176.9188	80.6744	23.8835	0.0000	0.0000	0.0000	0.0000	92.3071	213.3841	323.6403 (98)
Space heating												1458.2400 (98)
Space heating per m2												(98) / (4) = 31.8811 (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	432.7763	340.6962	349.0340	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9602	0.9827	0.9745	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	415.5406	334.8140	340.1361	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	637.3840	610.2143	571.2746	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	159.7272	204.8978	171.9670	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												536.5920 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												fc = cooled area / (4) = 1.0000 (105)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	39.9318	51.2244	42.9917	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling per m2													134.1480 (107)
Energy for space heating													2.9328 (108)
Energy for space cooling													31.8811 (99)
Total													2.9328 (108)
Target Fabric Energy Efficiency (TFEE)													34.8139 (109)
													40.0 (109)

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# 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	45.7400 (1b)	2.3900 (2b)	109.3186 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	45.7400		109.3186 (4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	109.3186 (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	0.2000 (18)
Number of sides sheltered				2	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)			7.2600	1.3258	9.6250		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	44.8400	9.7800	35.0600	0.2500	8.7650	52.8000	1851.1680 (29a)
External Wall to Corridor	3.9900	2.1200	1.8700	0.2200	0.4114	52.8000	98.7360 (29a)
Total net area of external elements Aum(A, m2)			48.8300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	24.4319		(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			45.7400			70.0000	3201.8000 (32d)
E-FC-4			45.7400			70.0000	3201.8000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 10593.0840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							231.5934 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3727 (36)
Total fabric heat loss							(33) + (36) = 28.8046 (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	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376 (38)
Average = Sum(39)m / 12 =	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422 (39)
HLP	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241 (40)
HLP (average)												1.0241 (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												1.5659 (42)
Average daily hot water use (litres/day)												71.3891 (43)
Daily hot water use	78.5281	75.6725	72.8169	69.9614	67.1058	64.2502	64.2502	67.1058	69.9614	72.8169	75.6725	78.5281 (44)
Energy conte	116.4548	101.8522	105.1023	91.6307	87.9219	75.8699	70.3046	80.6756	81.6391	95.1425	103.8555	112.7803 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1123.2292 (45)
Distribution loss (46)m = 0.15 x (45)m														
	17.4682	15.2778	15.7653	13.7446	13.1883	11.3805	10.5457	12.1013	12.2459	14.2714	15.5783	16.9170	16.9170	(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	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	13.9760	12.6103	13.9402	13.4667	13.8982	13.4298	13.8650	13.8865	13.4499	13.9228	13.5014	13.9691	13.9691	(61)
Total heat required for water heating calculated for each month	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	126.7494	(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	0.0000	(63)
Output from w/h	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	126.7494	(64)
RHI water heating demand													Total per year (kWh/year) = Sum(64)m =	1287.1451 (64)
Heat gains from water heating, kWh/month	42.2152	37.0184	38.4316	33.8339	32.7086	28.5842	26.8425	30.2962	30.5075	35.1156	37.9073	40.9917	40.9917	(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	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.4023	27.0030	21.9603	16.6254	12.4277	10.4920	11.3369	14.7362	19.7789	25.1138	29.3115	31.2472	31.2472	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.2688	205.3781	200.0627	188.7470	174.4628	161.0378	152.0690	149.9597	155.2751	166.5909	180.8750	194.3000	194.3000	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	(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	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	(71)
Water heating gains (Table 5)	56.7409	55.0869	51.6553	46.9915	43.9631	39.7003	36.0787	40.7208	42.3715	47.1984	52.6490	55.0964	55.0964	(72)
Total internal gains	370.6901	367.7462	353.9566	332.6420	311.1318	291.5082	279.7628	285.6949	297.7036	319.1812	343.1137	360.9218	360.9218	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W							
Southeast	2.0000	40.9830	0.4300	0.0000	0.7700	27.1390 (77)							
Southwest	3.9900	40.9830	0.4300	0.0000	0.7700	54.1422 (79)							
Northwest	1.2700	12.9465	0.4300	0.0000	0.7700	5.4440 (81)							
Northwest	2.5200	12.9465	0.4300	0.0000	0.7700	10.8022 (81)							
Solar gains	97.5274	159.8914	228.3501	320.8785	367.5351	389.7009	368.1243	324.6618	270.0865	188.4747	120.6865	82.0255	83)
Total gains	468.2175	527.6376	582.3067	653.5205	678.6669	681.2091	647.8871	610.3567	567.7901	507.6559	463.8001	442.9473	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	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178
alpha	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879
util living area	0.9678	0.9434	0.8838	0.7481	0.5708	0.3834	0.2457	0.2608	0.4884	0.7836	0.9341	0.9742	0.9742 (86)
MIT	20.3065	20.4585	20.6846	20.8887	20.9760	20.9974	20.9998	20.9998	20.9916	20.8841	20.5760	20.2581	20.2581 (87)
Th 2	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633 (88)
util rest of house	0.9596	0.9299	0.8584	0.7043	0.5133	0.3201	0.1781	0.1890	0.4151	0.7324	0.9158	0.9674	0.9674 (89)
MIT 2	19.1785	19.3905	19.6966	19.9502	20.0439	20.0620	20.0633	20.0632	20.0584	19.9521	19.5580	19.1104	19.1104 (90)
Living area fraction	19.6744	19.8601	20.1310	20.3628	20.4537	20.4733	20.4750	20.4750	20.4687	20.3619	20.0055	19.6150	19.6150 (92)
Temperature adjustment													0.0000
adjusted MIT	19.6744	19.8601	20.1310	20.3628	20.4537	20.4733	20.4750	20.4750	20.4687	20.3619	20.0055	19.6150	19.6150 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	447.3869	488.9009	501.0429	469.7806	364.8965	236.9857	134.6417	134.6296	253.8865	380.5900	424.1268	426.7365	426.7365 (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	4.7000 (96)
Heat loss rate W	701.4347	686.7105	615.0855	508.8390	372.5700	237.6426	134.6725	134.6709	256.1662	419.7931	576.4189	698.6515	698.6515 (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	1.0000 (97a)
Space heating kWh	189.0116	132.9280	84.8477	28.1221	5.7091	0.0000	0.0000	0.0000	0.0000	29.1670	109.6503	202.3047	202.3047 (98)
Space heating													781.7406 (98)
RHI space heating demand													782 (98)



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



**CALCULATION OF HEAT DEMAND 09 Jan 2014**

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# 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	45.7400 (1b)	2.3900 (2b)	109.3186 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	45.7400		109.3186 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 109.3186 (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	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 m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			7.2600	1.3258	9.6250		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	44.8400	9.7800	35.0600	0.2500	8.7650	52.8000	1851.1680 (29a)
External Wall to Corridor	3.9900	2.1200	1.8700	0.2200	0.4114	52.8000	98.7360 (29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			48.8300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	24.4319		(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			45.7400			70.0000	3201.8000 (32d)
E-FC-4			45.7400			70.0000	3201.8000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			10593.0840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							231.5934 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3727 (36)
Total fabric heat loss						(33) + (36) =	28.8046 (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	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376 (38)
Average = Sum(39)m / 12 =	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422 (39)
HLP	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241 (40)
HLP (average)	1.0241 (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	1.5659 (42)											
Average daily hot water use (litres/day)	71.3891 (43)											
Daily hot water use	78.5281	75.6725	72.8169	69.9614	67.1058	64.2502	64.2502	67.1058	69.9614	72.8169	75.6725	78.5281 (44)
Energy conte	116.4548	101.8522	105.1023	91.6307	87.9219	75.8699	70.3046	80.6756	81.6391	95.1425	103.8555	112.7803 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1123.2292 (45)
Distribution loss (46)m = 0.15 x (45)m														
	17.4682	15.2778	15.7653	13.7446	13.1883	11.3805	10.5457	12.1013	12.2459	14.2714	15.5783	16.9170	(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	13.9760	12.6103	13.9402	13.4667	13.8982	13.4298	13.8650	13.8865	13.4499	13.9228	13.5014	13.9691	(61)	
Total heat required for water heating calculated for each month	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(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	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(64)	
Heat gains from water heating, kWh/month	42.2152	37.0184	38.4316	33.8339	32.7086	28.5842	26.8425	30.2962	30.5075	35.1156	37.9073	40.9917	(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	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.4023	27.0030	21.9603	16.6254	12.4277	10.4920	11.3369	14.7362	19.7789	25.1138	29.3115	31.2472	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.2688	205.3781	200.0627	188.7470	174.4628	161.0378	152.0690	149.9597	155.2751	166.5909	180.8750	194.3000	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	(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)	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	(71)
Water heating gains (Table 5)	56.7409	55.0869	51.6553	46.9915	43.9631	39.7003	36.0787	40.7208	42.3715	47.1984	52.6490	55.0964	(72)
Total internal gains	370.6901	367.7462	353.9566	332.6420	311.1318	291.5082	279.7628	285.6949	297.7036	319.1812	343.1137	360.9218	(73)

#### 6. Solar gains

[Jan]	Area	Solar flux	Specific data	Specific data	Access	Gains							
	m <sup>2</sup>	Table 6a	g	FF	factor	W							
		W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d								
Southeast	2.0000	36.7938	0.4300	0.0000	0.7700	24.3649 (77)							
Southwest	3.9900	36.7938	0.4300	0.0000	0.7700	48.6079 (79)							
Northwest	1.2700	11.2829	0.4300	0.0000	0.7700	4.7444 (81)							
Northwest	2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (81)							
Solar gains	87.1314	153.1200	221.9972	296.0034	350.6599	356.5306	340.2351	298.1738	247.4236	172.5983	105.2198	74.0121	(83)
Total gains	457.8215	520.8661	575.9538	628.6455	661.7917	648.0388	619.9980	583.8686	545.1273	491.7795	448.3335	434.9340	(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	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	
alpha	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	
util living area	0.9733	0.9495	0.8990	0.7921	0.6305	0.4580	0.3317	0.3677	0.5762	0.8344	0.9501	0.9788	(86)
MIT	20.2477	20.4200	20.6392	20.8461	20.9589	20.9933	20.9990	20.9983	20.9797	20.8284	20.4969	20.1928	(87)
Th 2	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	(88)
util rest of house	0.9664	0.9375	0.8766	0.7527	0.5754	0.3930	0.2615	0.2935	0.5045	0.7919	0.9360	0.9733	(89)
MIT 2	19.0947	19.3368	19.6363	19.9005	20.0274	20.0592	20.0629	20.0626	20.0492	19.8872	19.4493	19.0168	(90)
Living area fraction													fLA = Living area / (4) =
MIT	19.6016	19.8130	20.0772	20.3162	20.4370	20.4699	20.4745	20.4740	20.4583	20.3010	19.9099	19.5338	(92)
Temperature adjustment													0.0000
adjusted MIT	19.6016	19.8130	20.0772	20.3162	20.4370	20.4699	20.4745	20.4740	20.4583	20.3010	19.9099	19.5338	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9623	0.9337	0.8769	0.7639	0.5979	0.4214	0.2924	0.3262	0.5353	0.8035	0.9333	0.9694	(94)
Useful gains	440.5811	486.3563	505.0714	480.1979	395.6584	273.0971	181.2697	190.4455	291.8214	395.1646	418.4169	421.6257	(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	716.7627	698.5584	635.9875	534.7617	409.2587	274.9593	181.4889	190.8343	297.8360	454.4147	600.0435	718.2702	(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	205.4791	142.5999	97.4016	39.2859	10.1187	0.0000	0.0000	0.0000	0.0000	44.0821	130.7711	220.7035	(98)
Space heating													890.4418 (98)
Space heating per m <sup>2</sup>													(98) / (4) = 19.4675 (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													952.3442 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	205.4791	142.5999	97.4016	39.2859	10.1187	0.0000	0.0000	0.0000	0.0000	44.0821	130.7711	220.7035	(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)	219.7638	152.5132	104.1728	42.0170	10.8221	0.0000	0.0000	0.0000	0.0000	47.1466	139.8622	236.0465	(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	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(64)
Efficiency of water heater (217)m	89.2300	89.0466	88.7116	88.1481	87.5799	87.3000	87.3000	87.3000	87.3000	88.1977	88.9578	87.3000	(216)
Fuel for water heating, kWh/month	146.1738	128.5421	134.1905	119.2282	116.2595	102.2906	96.4142	108.3185	108.9221	123.6601	131.9243	141.9274	(219)
Water heating fuel used													1457.8513 (219)
Annual totals kWh/year													
Space heating fuel - main system													952.3442 (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)													32.2816 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													107.2816 (231)
Electricity for lighting (calculated in Appendix L)													214.7654 (232)
Total delivered energy for all uses													2732.2424 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	952.3442	3.4800	33.1416 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1457.8513	3.4800	50.7332 (247)
Mechanical ventilation fans	32.2816	13.1900	4.2579 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	214.7654	13.1900	28.3275 (250)
Additional standing charges			120.0000 (251)
Total energy cost			246.3528 (255)

#### 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1403 (257)
SAP value		84.0932
SAP rating (Section 12)		84 (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	952.3442	0.2160	205.7064 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1457.8513	0.2160	314.8959 (264)
Space and water heating			520.6022 (265)
Pumps and fans	107.2816	0.5190	55.6791 (267)
Energy for lighting	214.7654	0.5190	111.4632 (268)
Total kg/year			687.7446 (272)
CO2 emissions per m2			15.0400 (273)
EI value			89.8438
EI rating			90 (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	$3.48 / 0.8820 = 3.946$ , stars = 4
Water heating environmental impact	$0.216 / 0.8820 = 0.2449$ , stars = 4

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



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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# 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	45.7400 (1b)	2.3900 (2b)	109.3186 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	45.7400		109.3186 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 109.3186 (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	0.2000 (18)							
Number of sides sheltered				2	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)							
Wind speed	Jan 4.9000	Feb 4.8000	Mar 4.7000	Apr 4.2000	May 4.2000	Jun 3.7000	Jul 3.8000	Aug 3.8000	Sep 4.0000	Oct 4.2000	Nov 4.3000	Dec 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 m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			7.2600	1.3258	9.6250		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	44.8400	9.7800	35.0600	0.2500	8.7650	52.8000	1851.1680 (29a)
External Wall to Corridor	3.9900	2.1200	1.8700	0.2200	0.4114	52.8000	98.7360 (29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			48.8300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	24.4319	(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			45.7400			70.0000	3201.8000 (32d)
E-FC-4			45.7400			70.0000	3201.8000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 10593.0840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							231.5934 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3727 (36)
Total fabric heat loss							(33) + (36) = 28.8046 (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	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376	18.0376 (38)
Average = Sum(39)m / 12 =	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422	46.8422 (39)
HLP	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241	1.0241 (40)
HLP (average)												1.0241 (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												1.5659 (42)
Average daily hot water use (litres/day)												71.3891 (43)
Daily hot water use	78.5281	75.6725	72.8169	69.9614	67.1058	64.2502	64.2502	67.1058	69.9614	72.8169	75.6725	78.5281 (44)
Energy conte	116.4548	101.8522	105.1023	91.6307	87.9219	75.8699	70.3046	80.6756	81.6391	95.1425	103.8555	112.7803 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Energy content (annual)												Total = Sum(45)m =	1123.2292 (45)
Distribution loss (46)m = 0.15 x (45)m													
	17.4682	15.2778	15.7653	13.7446	13.1883	11.3805	10.5457	12.1013	12.2459	14.2714	15.5783	16.9170	(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	13.9760	12.6103	13.9402	13.4667	13.8982	13.4298	13.8650	13.8865	13.4499	13.9228	13.5014	13.9691	(61)
Total heat required for water heating calculated for each month													
	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(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	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(64)
	Total per year (kWh/year) = Sum(64)m =											1287.1451 (64)	
Heat gains from water heating, kWh/month	42.2152	37.0184	38.4316	33.8339	32.7086	28.5842	26.8425	30.2962	30.5075	35.1156	37.9073	40.9917	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	93.9515	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.4023	27.0030	21.9603	16.6254	12.4277	10.4920	11.3369	14.7362	19.7789	25.1138	29.3115	31.2472	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.2688	205.3781	200.0627	188.7470	174.4628	161.0378	152.0690	149.9597	155.2751	166.5909	180.8750	194.3000	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	45.9610	(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)	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	-62.6344	(71)
Water heating gains (Table 5)	56.7409	55.0869	51.6553	46.9915	43.9631	39.7003	36.0787	40.7208	42.3715	47.1984	52.6490	55.0964	(72)
Total internal gains	370.6901	367.7462	353.9566	332.6420	311.1318	291.5082	279.7628	285.6949	297.7036	319.1812	343.1137	360.9218	(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				
Southeast	2.0000		40.9830		0.4300		0.0000		0.7700		27.1390 (77)		
Southwest	3.9900		40.9830		0.4300		0.0000		0.7700		54.1422 (79)		
Northwest	1.2700		12.9465		0.4300		0.0000		0.7700		5.4440 (81)		
Northwest	2.5200		12.9465		0.4300		0.0000		0.7700		10.8022 (81)		
Solar gains	97.5274	159.8914	228.3501	320.8785	367.5351	389.7009	368.1243	324.6618	270.0865	188.4747	120.6865	82.0255	(83)
Total gains	468.2175	527.6376	582.3067	653.5205	678.6669	681.2091	647.8871	610.3567	567.7901	507.6559	463.8001	442.9473	(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	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	62.8178	
alpha	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	5.1879	
util living area	0.9678	0.9434	0.8838	0.7481	0.5708	0.3834	0.2457	0.2608	0.4884	0.7836	0.9341	0.9742	(86)
MIT	20.3065	20.4585	20.6846	20.8887	20.9760	20.9974	20.9998	20.9998	20.9916	20.8841	20.5760	20.2581	(87)
Th 2	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	20.0633	(88)
util rest of house	0.9596	0.9299	0.8584	0.7043	0.5133	0.3201	0.1781	0.1890	0.4151	0.7324	0.9158	0.9674	(89)
MIT 2	19.1785	19.3905	19.6966	19.9502	20.0439	20.0620	20.0633	20.0632	20.0584	19.9521	19.5580	19.1104	(90)
Living area fraction	fLA = Living area / (4) =											0.4397 (91)	
MIT	19.6744	19.8601	20.1310	20.3628	20.4537	20.4733	20.4750	20.4750	20.4687	20.3619	20.0055	19.6150	(92)
Temperature adjustment													0.0000
adjusted MIT	19.6744	19.8601	20.1310	20.3628	20.4537	20.4733	20.4750	20.4750	20.4687	20.3619	20.0055	19.6150	(93)

#### 8. Space heating requirement

Utilisation	0.9555	0.9266	0.8604	0.7188	0.5377	0.3479	0.2078	0.2206	0.4471	0.7497	0.9145	0.9634	(94)
Useful gains	447.3869	488.9009	501.0429	469.7806	364.8965	236.9857	134.6417	134.6296	253.8865	380.5900	424.1268	426.7365	(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	701.4347	686.7105	615.0855	508.8390	372.5700	237.6426	134.6725	134.6709	256.1662	419.7931	576.4189	698.6515	(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	189.0116	132.9280	84.8477	28.1221	5.7091	0.0000	0.0000	0.0000	0.0000	29.1670	109.6503	202.3047	(98)
Space heating												781.7406 (98)	
Space heating per m2												(98) / (4) = 17.0910 (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													836.0862 (211)
Space heating requirement	189.0116	132.9280	84.8477	28.1221	5.7091	0.0000	0.0000	0.0000	0.0000	29.1670	109.6503	202.3047	(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)	202.1514	142.1690	90.7462	30.0771	6.1060	0.0000	0.0000	0.0000	0.0000	31.1947	117.2731	216.3687	(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	130.4309	114.4624	119.0425	105.0974	101.8200	89.2997	84.1696	94.5620	95.0890	109.0653	117.3569	126.7494	(64)
Efficiency of water heater (217)m	89.1655	88.9908	88.6038	87.9565	87.4642	87.3000	87.3000	87.3000	87.3000	87.9562	88.8169	87.3000	(216)
Fuel for water heating, kWh/month	146.2796	128.6228	134.3538	119.4879	116.4134	102.2906	96.4142	108.3185	108.9221	123.9995	132.1334	142.0321	(219)
Water heating fuel used													1459.2678 (219)
Annual totals kWh/year													
Space heating fuel - main system													836.0862 (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)													32.2816 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													107.2816 (231)
Electricity for lighting (calculated in Appendix L)													214.7654 (232)
Total delivered energy for all uses													2617.4010 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	836.0862	3.9200	32.7746 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1459.2678	3.9200	57.2033 (247)
Mechanical ventilation fans	32.2816	16.9600	5.4750 (249)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	214.7654	16.9600	36.4242 (250)
Additional standing charges			88.0000 (251)
Total energy cost			232.5970 (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	836.0862	0.2160	180.5946 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1459.2678	0.2160	315.2018 (264)
Space and water heating			495.7965 (265)
Pumps and fans	107.2816	0.5190	55.6791 (267)
Energy for lighting	214.7654	0.5190	111.4632 (268)
Total kg/year			662.9388 (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	836.0862	1.2200	1020.0252 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1459.2678	1.2200	1780.3067 (264)
Space and water heating			2800.3319 (265)
Pumps and fans	107.2816	3.0700	329.3544 (267)
Energy for lighting	214.7654	3.0700	659.3296 (268)
Primary energy kWh/year			3789.0160 (272)
Primary energy kWh/m2/year			82.8381 (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 84  
 Current environmental impact rating: B 90

(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	Typical annual savings	Energy efficiency	Environmental impact
(none)	Total Savings £0	0.00 kg/m <sup>2</sup>	

Potential energy efficiency rating: B 84  
 Potential environmental impact rating: B 90

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	£55	£55	£0
Mains gas	£178	£178	£0
Space heating	£139	£139	£0
Water heating	£57	£57	£0
Lighting	£36	£36	£0
Total cost of fuels	£233	£233	£0
Total cost of uses	£232	£232	£0
Delivered energy	57 kWh/m <sup>2</sup>	57 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.7 tonnes	0.7 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	14 kg/m <sup>2</sup>	14 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	83 kWh/m <sup>2</sup>	83 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014  
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No improvements selected / applicable  
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# 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	Yes
SAP Region	East Anglia
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	231.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

#### Overheating Calculation

Summer ventilation heat loss coefficient	216.45 (P1)
Transmission heat loss coefficient	28.80 (37)
Summer heat loss coefficient	245.26 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South East	2.0000	122.3147	0.4300	0.0000	0.9000	94.6716
South West	3.9900	122.3147	0.4300	0.0000	0.9000	188.8698
North West	1.2700	100.0415	0.4300	0.0000	0.9000	49.1694
North West	2.5200	100.0415	0.4300	0.0000	0.9000	97.5644

total: 430.2751

Solar gains	455	430	379	(P4)
Internal gains	289	277	283	
Total summer gains	744	707	662	(P5)

Summer gain/loss ratio	3.03	2.88	2.70	(P6)
Summer external temperature	15.40	17.60	17.60	
Thermal mass temperature increment (TMP = 231.6)	0.38	0.38	0.38	
Threshold temperature	18.81	20.86	20.68	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight