

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



<b>Property Reference</b>	4907-0015-3990-023			<b>Issued on Date</b>	12/02/2020
<b>Assessment Reference</b>	023	<b>Prop Type Ref</b>	1FF Semi		
<b>Property</b>	Plot 023, 2 Bed, K, Ba, ES, Welwyn Garden City				
<b>SAP Rating</b>	85 B	<b>DER</b>	15.43	<b>TER</b>	17.14
<b>Environmental</b>	90 B	<b>% DER&lt;TER</b>	9.96		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.74	<b>DFEE</b>	32.58	<b>TFEE</b>	36.39
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	10.47		
<b>Assessor Details</b>	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk			<b>Assessor ID</b>	4907-0015
<b>Client</b>	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 56 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) 17.14 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.43 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)36.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)32.6 kWh/m<sup>2</sup>/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	(no roof)		
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): Not significant OK  
Based on:  
Overshading: Average  
Windows facing North East: 3.99 m<sup>2</sup>, No overhang  
Windows facing South West: 3.97 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	2.3900 (2b)	134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	134.7960 (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	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)			5.4400	1.3258	7.2121		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.1200	7.9600	26.1600	0.2500	6.5400	52.8000	1381.2480 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			54.3700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.0086		(33)
AAC Party Wall			24.9900	0.0000	0.0000	52.8000	1319.4720 (32)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 13155.4440 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							233.2526 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5734 (36)
Total fabric heat loss							(33) + (36) = 27.5821 (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	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413 (38)
Average = Sum(39)m / 12 =	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234 (39)
HLP	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834 (40)
HLP (average)												0.8834 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)

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

Energy content (annual)												Total = Sum(45)m =	1239.9620 (45)
Distribution loss (46)m = 0.15 x (45)m													
	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752	(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	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156	(61)
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Total per year (kWh/year) = Sum(64)m =												1404.3028 (64)	
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005	(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	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.6374	13.8890	11.2953	8.5513	6.3922	5.3965	5.8311	7.5795	10.1732	12.9173	15.0764	16.0720	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	(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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	(71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502	(72)
Total internal gains	295.7624	293.8871	283.2215	266.2102	249.1978	232.6781	221.8876	227.0618	235.7611	252.9524	272.6392	287.1546	(73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W							
Northeast	3.9900	11.2829	0.4300	0.0000	0.7700	14.9058 (75)							
Southwest	1.4500	36.7938	0.4300	0.0000	0.7700	17.6645 (79)							
Southwest	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997 (79)							
Solar gains	63.2700	112.7234	167.3841	229.4400	277.1119	283.9580	270.0828	233.1645	188.6611	128.1292	76.6846	53.5625	(83)
Total gains	359.0324	406.6105	450.6055	495.6502	526.3096	516.6361	491.9705	460.2263	424.4222	381.0816	349.3238	340.7172	(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	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	
alpha	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	
util living area	0.9960	0.9909	0.9757	0.9242	0.7953	0.6029	0.4435	0.4938	0.7519	0.9508	0.9911	0.9970	(86)
MIT	20.1207	20.2601	20.4759	20.7317	20.9170	20.9863	20.9981	20.9965	20.9543	20.7112	20.3581	20.0783	(87)
Th 2	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	(88)
util rest of house	0.9948	0.9883	0.9686	0.9028	0.7472	0.5317	0.3621	0.4081	0.6828	0.9321	0.9881	0.9961	(89)
MIT 2	19.0032	19.2057	19.5160	19.8705	20.1020	20.1724	20.1809	20.1801	20.1458	19.8500	19.3493	18.9415	(90)
Living area fraction	19.4302	19.6085	19.8828	20.1996	20.4134	20.4834	20.4931	20.4920	20.4547	20.1790	19.7348	19.3759	(92)
Temperature adjustment	19.4302	19.6085	19.8828	20.1996	20.4134	20.4834	20.4931	20.4920	20.4547	20.1790	19.7348	19.3759	(93)
adjusted MIT	19.4302	19.6085	19.8828	20.1996	20.4134	20.4834	20.4931	20.4920	20.4547	20.1790	19.7348	19.3759	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9933	0.9859	0.9654	0.9033	0.7616	0.5585	0.3933	0.4409	0.7071	0.9320	0.9859	0.9950	(94)
Ext temp.	356.6361	400.8754	435.0275	447.7302	400.8308	288.5350	193.4777	202.9351	300.1056	355.1844	344.3940	338.9989	(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	753.8377	732.8296	666.7759	562.9821	434.1322	293.1315	193.9676	203.8775	316.6135	477.2603	629.5083	756.1130	(97)
Space heating kWh	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 per m <sup>2</sup>	295.5180	223.0732	172.4208	82.9814	24.7762	0.0000	0.0000	0.0000	0.0000	90.8245	205.2822	310.3329	(98)
(98) / (4) =												24.9151 (99)	

# FULL SAP CALCULATION PRINTOUT

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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													1502.8976 (211)
Space heating requirement	295.5180	223.0732	172.4208	82.9814	24.7762	0.0000	0.0000	0.0000	0.0000	90.8245	205.2822	310.3329	(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)	316.0620	238.5810	184.4072	88.7502	26.4986	0.0000	0.0000	0.0000	0.0000	97.1385	219.5532	331.9069	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Efficiency of water heater (217)m	89.4331	89.3236	89.0961	88.6156	87.8670	87.3000	87.3000	87.3000	87.3000	88.6570	89.2425	89.4877	(217)
Fuel for water heating, kWh/month	159.4282	140.0390	145.9161	129.3833	126.3141	111.3518	104.8107	117.9550	118.6751	134.2132	143.6439	154.7885	(219)
Water heating fuel used													1586.5189 (219)
Annual totals kWh/year													
Space heating fuel - main system													1502.8976 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9550, total flow = 29.0000, SFP = 0.2398)													39.4399 (230a)
mechanical ventilation fans (SFP = 0.2398)													30.0000 (230c)
central heating pump													45.0000 (230e)
main heating flue fan													114.4399 (231)
Total electricity for the above, kWh/year													276.1610 (232)
Electricity for lighting (calculated in Appendix L)													3480.0174 (238)
Total delivered energy for all uses													

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	1502.8976	0.2160	324.6259	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1586.5189	0.2160	342.6881	(264)
Space and water heating			667.3140	(265)
Pumps and fans	114.4399	0.5190	59.3943	(267)
Energy for lighting	276.1610	0.5190	143.3275	(268)
Total CO2, kg/year			870.0358	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.4300	(273)

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

DER			15.4300 ZC1
Total Floor Area		TFA	56.4000
Assumed number of occupants		N	1.8782
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			17.2085 ZC2
CO2 emissions from cooking, equation (L16)			2.9092 ZC3
Total CO2 emissions			35.5477 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m <sup>2</sup> /year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			35.5477 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	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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) =	0.1484 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.3984 (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) =		0.3386 (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	0.4317	0.4233	0.4148	0.3725	0.3640	0.3217	0.3217	0.3132	0.3386	0.3640	0.3809	0.3979 (22b)
Effective ac	0.5932	0.5896	0.5860	0.5694	0.5663	0.5517	0.5517	0.5491	0.5573	0.5663	0.5726	0.5792 (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)			7.9600	1.3258	10.5530		(27)					
External Wall	34.1200	7.9600	26.1600	0.1800	4.7088		(29a)					
External Wall to Stairwell	20.2500	2.1200	18.1300	0.1800	3.2634		(29a)					
Total net area of external elements Aum(A, m2)			54.3700				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 20.6452		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6733 (36)					
Total fabric heat loss							(33) + (36) = 25.3185 (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	26.3870	26.2261	26.0683	25.3271	25.1884	24.5429	24.5429	24.4234	24.7916	25.1884	25.4690	25.7622 (38)
Average = Sum(39)m / 12 =	51.7056	51.5446	51.3868	50.6456	50.5070	49.8614	49.8614	49.7419	50.1101	50.5070	50.7875	51.0808 (39)
	50.6450 (39)											
HLP	0.9168	0.9139	0.9111	0.8980	0.8955	0.8841	0.8841	0.8819	0.8885	0.8955	0.9005	0.9057 (40)
HLP (average)												0.8980 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)												Total = Sum(45)m = 1239.9620 (45)
Distribution loss (46)m = 0.15 x (45)m	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752 (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	44.1759	38.4498	40.9631	38.0871	37.7503	34.9779	36.1439	37.7503	38.0871	40.9631	41.1962	44.1759 (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	172.7334	150.8871	156.9882	139.2406	134.8095	118.7327	113.7550	126.8101	128.2106	145.9933	155.8450	168.6770 (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	172.7334	150.8871	156.9882	139.2406	134.8095	118.7327	113.7550	126.8101	128.2106	145.9933	155.8450	168.6770 (64)
Heat gains from water heating, kWh/month	53.7893	46.9978	48.8191	43.1553	41.7098	36.5929	34.8417	39.0500	39.4878	45.1633	48.4198	52.4406 (65)
												1712.6825 (64)

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

Metabolic gains (Table 5), Watts	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.6374	13.8890	11.2953	8.5513	6.3922	5.3965	5.8311	7.5795	10.1732	12.9173	15.0764	16.0720 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	72.2975	69.9373	65.6171	59.9380	56.0615	50.8235	46.8302	52.4865	54.8442	60.7034	67.2497	70.4847 (72)
Total internal gains	305.8940	303.4850	292.2882	274.7473	257.2022	240.1512	229.3659	235.0710	244.3053	262.0263	282.2412	297.2891 (73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
Northeast	3.9900	11.2829	0.6300	0.7000	0.7700	13.7584 (75)						
Southwest	3.9700	36.7938	0.6300	0.7000	0.7700	44.6414 (79)						
Solar gains	58.3997	104.0463	154.4994	211.7785	255.7807	262.0998	249.2927	215.2162	174.1386	118.2662	70.7816	49.4395 (83)
Total gains	364.2937	407.5313	446.7876	486.5258	512.9829	502.2511	478.6586	450.2873	418.4439	380.2925	353.0228	346.7286 (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)												
tau	75.7494	75.9860	76.2193	77.3347	77.5471	78.5510	78.5510	78.7398	78.1612	77.5471	77.1187	76.6760
alpha	6.0500	6.0657	6.0813	6.1556	6.1698	6.2367	6.2367	6.2493	6.2107	6.1698	6.1412	6.1117
util living area	0.9969	0.9931	0.9817	0.9384	0.8199	0.6211	0.4564	0.5045	0.7676	0.9583	0.9929	0.9977 (86)
MIT	20.1299	20.2603	20.4664	20.7273	20.9142	20.9875	20.9984	20.9971	20.9570	20.7191	20.3799	20.1073 (87)
Th 2	20.1533	20.1557	20.1581	20.1692	20.1713	20.1811	20.1811	20.1829	20.1773	20.1713	20.1671	20.1627 (88)
util rest of house	0.9959	0.9910	0.9757	0.9189	0.7720	0.5478	0.3725	0.4168	0.6971	0.9409	0.9902	0.9969 (89)
MIT 2	18.9895	19.1809	19.4800	19.8531	20.0899	20.1729	20.1805	20.1817	20.1445	19.8501	19.3646	18.9637 (90)
Living area fraction									fLA = Living area / (4) =			0.3821 (91)
MIT	19.4252	19.5933	19.8569	20.1871	20.4049	20.4842	20.4930	20.4932	20.4550	20.1821	19.7526	19.4007 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4252	19.5933	19.8569	20.1871	20.4049	20.4842	20.4930	20.4932	20.4550	20.1821	19.7526	19.4007 (93)

#### 8. Space heating requirement

Utilisation	0.9947	0.9891	0.9731	0.9194	0.7864	0.5755	0.4047	0.4504	0.7223	0.9411	0.9885	0.9960 (94)
Useful gains	362.3714	403.0885	434.7543	447.2976	403.3925	289.0361	193.6945	202.8210	302.2263	357.9099	348.9476	345.3336 (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	782.0582	757.3613	686.3682	571.6429	439.6556	293.3938	194.1096	203.6056	318.4474	483.9644	642.5914	776.4611 (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	312.2470	238.0713	187.2007	89.5287	26.9798	0.0000	0.0000	0.0000	0.0000	93.7846	211.4235	320.7589 (98)
Space heating												1479.9945 (98)
Space heating per m2												26.2410 (99)

#### 8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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													1584.5765 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	312.2470	238.0713	187.2007	89.5287	26.9798	0.0000	0.0000	0.0000	0.0000	93.7846	211.4235	320.7589	(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)	334.3115	254.8943	200.4291	95.8551	28.8863	0.0000	0.0000	0.0000	0.0000	100.4117	226.3635	343.4249	(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	172.7334	150.8871	156.9882	139.2406	134.8095	118.7327	113.7550	126.8101	128.2106	145.9933	155.8450	168.6770	(64)
Efficiency of water heater	86.5239	86.1943	85.4952	83.9715	81.8245	80.3000	80.3000	80.3000	80.3000	83.9694	85.8196	86.6442	(217)
Fuel for water heating, kWh/month	199.6366	175.0545	183.6222	165.8188	164.7545	147.8614	141.6625	157.9205	159.6645	173.8649	181.5960	194.6778	(219)
Water heating fuel used													2046.1340 (219)
Annual totals kWh/year													
Space heating fuel - main system													1584.5765 (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)													276.1610 (232)
Total delivered energy for all uses													3981.8715 (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	1584.5765	0.2160	342.2685 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2046.1340	0.2160	441.9650 (264)
Space and water heating			784.2335 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	276.1610	0.5190	143.3275 (268)
Total CO2, kg/m2/year			966.4860 (272)
Emissions per m2 for space and water heating			13.9048 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.5413 (272b)
Emissions per m2 for pumps and fans			0.6902 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.9048 * 1.00) + 2.5413 + 0.6902, rounded to 2 d.p.			17.1400 (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	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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) = 0.1484 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3484 (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) = 0.2961 (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	0.3775	0.3701	0.3627	0.3257	0.3183	0.2813	0.2813	0.2739	0.2961	0.3183	0.3331	0.3479 (22b)
Effective ac	0.5713	0.5685	0.5658	0.5530	0.5507	0.5396	0.5396	0.5375	0.5438	0.5507	0.5555	0.5605 (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)			5.4400	1.3258	7.2121		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.1200	7.9600	26.1600	0.2500	6.5400	52.8000	1381.2480 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			54.3700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	23.0086			(33)
AAC Party Wall			24.9900	0.0000	0.0000	52.8000	1319.4720 (32)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			30.0000	1692.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =	10899.4440 (34)	
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K						193.2526 (35)	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)						4.5734 (36)	
Total fabric heat loss					(33) + (36) =	27.5821 (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
(38)m	25.4117	25.2886	25.1679	24.6011	24.4951	24.0014	24.0014	23.9100	24.1916	24.4951	24.7096	24.9339 (38)
Heat transfer coeff	52.9937	52.8706	52.7500	52.1832	52.0771	51.5835	51.5835	51.4921	51.7736	52.0771	52.2917	52.5159 (39)
Average = Sum(39)m / 12 =	52.1827 (39)											
HLP	0.9396	0.9374	0.9353	0.9252	0.9234	0.9146	0.9146	0.9130	0.9180	0.9234	0.9272	0.9311 (40)
HLP (average)	0.9252 (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	1.8782 (42)											
Average daily hot water use (litres/day)	78.8083 (43)											
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)	Total = Sum(45)m = 1239.9620 (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	(56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Heat gains from water heating, kWh/month	27.3185	23.8929	24.6553	21.4951	20.6251	17.7979	16.4924	18.9252	19.1512	22.3189	24.3629	26.4565	(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	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.6374	13.8890	11.2953	8.5513	6.3922	5.3965	5.8311	7.5795	10.1732	12.9173	15.0764	16.0720	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	(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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	(71)
Water heating gains (Table 5)	36.7184	35.5549	33.1389	29.8543	27.7219	24.7193	22.1671	25.4371	26.5990	29.9986	33.8373	35.5598	(72)
Total internal gains	267.3149	266.1026	256.8100	241.6637	225.8626	211.0470	201.7028	205.0216	213.0600	228.3214	245.8288	259.3643	(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				
Northeast		3.9900	11.2829	0.4300		0.0000		0.7700	14.9058	(75)			
Southwest		1.4500	36.7938	0.4300		0.0000		0.7700	17.6645	(79)			
Southwest		2.5200	36.7938	0.4300		0.0000		0.7700	30.6997	(79)			
Solar gains	63.2700	112.7234	167.3841	229.4400	277.1119	283.9580	270.0828	233.1645	188.6611	128.1292	76.6846	53.5625	(83)
Total gains	330.5849	378.8260	424.1941	471.1037	502.9744	495.0050	471.7856	438.1861	401.7211	356.4507	322.5134	312.9268	(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	57.1317	57.2647	57.3957	58.0191	58.1373	58.6937	58.6937	58.7979	58.4781	58.1373	57.8988	57.6515		
alpha	4.8088	4.8176	4.8264	4.8679	4.8758	4.9129	4.9129	4.9199	4.8985	4.8758	4.8599	4.8434		
util living area	0.9945	0.9887	0.9733	0.9257	0.8138	0.6335	0.4741	0.5282	0.7783	0.9514	0.9892	0.9957	0.9957	(86)
MIT	19.8159	19.9847	20.2499	20.5828	20.8397	20.9646	20.9930	20.9884	20.9047	20.5673	20.1293	19.7828	19.7828	(87)
Th 2	20.1340	20.1358	20.1376	20.1461	20.1477	20.1551	20.1551	20.1565	20.1523	20.1477	20.1445	20.1411	20.1411	(88)
util rest of house	0.9931	0.9858	0.9664	0.9066	0.7699	0.5616	0.3864	0.4370	0.7139	0.9349	0.9860	0.9947	0.9947	(89)
MIT 2	19.0466	19.2156	19.4782	19.8049	20.0351	20.1368	20.1528	20.1523	20.0955	19.7973	19.3671	19.0194	19.0194	(90)
Living area fraction										fLA = Living area / (4) =		0.3821	0.3821	(91)
MIT	19.3406	19.5095	19.7731	20.1021	20.3425	20.4531	20.4738	20.4718	20.4046	20.0915	19.6583	19.3111	19.3111	(92)
Temperature adjustment												0.0000	0.0000	
adjusted MIT	19.3406	19.5095	19.7731	20.1021	20.3425	20.4531	20.4738	20.4718	20.4046	20.0915	19.6583	19.3111	19.3111	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	327.7581	372.4882	408.4563	426.5644	392.6525	290.9533	198.1223	206.7171	295.0680	332.7978	317.2517	310.8272	310.8272	(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	4.2000	(96)
Heat loss rate W	797.0553	772.4123	700.1534	584.5609	450.0786	301.9218	199.8250	209.6638	326.4145	494.2924	656.6963	793.5718	793.5718	(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	349.1571	268.7490	217.0227	113.7575	42.7250	0.0000	0.0000	0.0000	0.0000	120.1519	244.4001	359.1619	359.1619	(98)
Space heating												1715.1253	1715.1253	(98)
Space heating per m2													30.4100	(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	484.8848	381.7178	391.3397	0.0000	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9267	0.9626	0.9489	0.0000	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	449.3369	367.4511	371.3470	0.0000	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	649.4901	621.0207	582.9737	0.0000	0.0000	0.0000	0.0000	0.0000	(103)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	144.1103	188.6558	157.4503	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling Cooled fraction												490.2164 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling												
Space cooling per m2	0.0000	0.0000	0.0000	0.0000	0.0000	36.0276	47.1639	39.3626	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												122.5541 (107)
Energy for space cooling												2.1729 (108)
Total												30.4100 (99)
Dwelling Fabric Energy Efficiency (DFEE)												2.1729 (108)
												32.5830 (109)
												32.6 (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	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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) =	0.1484 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.3984 (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) =	0.3386 (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	0.4317	0.4233	0.4148	0.3725	0.3640	0.3217	0.3217	0.3132	0.3386	0.3640	0.3809	0.3979 (22b)
	0.5932	0.5896	0.5860	0.5694	0.5663	0.5517	0.5517	0.5491	0.5573	0.5663	0.5726	0.5792 (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)			7.9600	1.3258	10.5530		(27)					
External Wall	34.1200	7.9600	26.1600	0.1800	4.7088		(29a)					
External Wall to Stairwell	20.2500	2.1200	18.1300	0.1800	3.2634		(29a)					
Total net area of external elements Aum(A, m2)			54.3700				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 20.6452		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6733 (36)					
Total fabric heat loss							(33) + (36) = 25.3185 (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	26.3870	26.2261	26.0683	25.3271	25.1884	24.5429	24.5429	24.4234	24.7916	25.1884	25.4690	25.7622 (38)
Average = Sum(39)m / 12 =	51.7056	51.5446	51.3868	50.6456	50.5070	49.8614	49.8614	49.7419	50.1101	50.5070	50.7875	51.0808 (39)
	50.6450											50.6450 (39)
HLP	0.9168	0.9139	0.9111	0.8980	0.8955	0.8841	0.8841	0.8819	0.8885	0.8955	0.9005	0.9057 (40)
HLP (average)												0.8980 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)												Total = Sum(45)m = 1239.9620 (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  
 27.3185 23.8929 24.6553 21.4951 20.6251 17.7979 16.4924 18.9252 19.1512 22.3189 24.3629 26.4565 (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	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.6374	13.8890	11.2953	8.5513	6.3922	5.3965	5.8311	7.5795	10.1732	12.9173	15.0764	16.0720 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	36.7184	35.5549	33.1389	29.8543	27.7219	24.7193	22.1671	25.4371	26.5990	29.9986	33.8373	35.5598 (72)
Total internal gains	267.3149	266.1026	256.8100	241.6637	225.8626	211.0470	201.7028	205.0216	213.0600	228.3214	245.8288	259.3643 (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					
Northeast	3.9900	11.2829	0.6300	0.7000	0.7700	13.7584 (75)						
Southwest	3.9700	36.7938	0.6300	0.7000	0.7700	44.6414 (79)						
Solar gains	58.3997	104.0463	154.4994	211.7785	255.7807	262.0998	249.2927	215.2162	174.1386	118.2662	70.7816	49.4395 (83)
Total gains	325.7146	370.1489	411.3094	453.4422	481.6433	473.1468	450.9956	420.2379	387.1986	346.5877	316.6105	308.8037 (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	75.7494	75.9860	76.2193	77.3347	77.5471	78.5510	78.5510	78.7398	78.1612	77.5471	77.1187	76.6760
alpha	6.0500	6.0657	6.0813	6.1556	6.1698	6.2367	6.2367	6.2493	6.2107	6.1698	6.1412	6.1117
util living area	0.9983	0.9958	0.9877	0.9539	0.8495	0.6545	0.4837	0.5389	0.8082	0.9724	0.9960	0.9988 (86)
MIT	20.0638	20.1974	20.4101	20.6854	20.8943	20.9835	20.9978	20.9959	20.9426	20.6713	20.3186	20.0420 (87)
Th 2	20.1533	20.1557	20.1581	20.1692	20.1713	20.1811	20.1811	20.1829	20.1773	20.1713	20.1671	20.1627 (88)
util rest of house	0.9977	0.9945	0.9836	0.9382	0.8048	0.5791	0.3952	0.4461	0.7406	0.9600	0.9944	0.9984 (89)
MIT 2	19.2929	19.4280	19.6405	19.9156	20.1011	20.1736	20.1805	20.1817	20.1462	19.9082	19.5586	19.2789 (90)
Living area fraction	fLA = Living area / (4) = 0.3821 (91)											
MIT	19.5875	19.7220	19.9346	20.2097	20.4042	20.4830	20.4928	20.4928	20.4505	20.1998	19.8490	19.5705 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.5875	19.7220	19.9346	20.2097	20.4042	20.4830	20.4928	20.4928	20.4505	20.1998	19.8490	19.5705 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9972	0.9936	0.9822	0.9391	0.8184	0.6076	0.4291	0.4817	0.7647	0.9605	0.9936	0.9980 (94)
Useful gains	324.8160	367.7816	403.9930	425.8307	394.1543	287.5001	193.5221	202.4436	296.0810	332.8988	314.5992	308.1781 (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	790.4475	763.9919	690.3588	572.7893	439.6203	293.3362	194.0989	203.5819	318.2245	484.8552	647.4897	785.1363 (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	346.4298	266.2533	213.0561	105.8102	33.8267	0.0000	0.0000	0.0000	0.0000	113.0556	239.6812	354.8570 (98)
Space heating per m2	(98) / (4) = 29.6626 (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	468.6975	368.9747	378.0384	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9522	0.9804	0.9709	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	446.2899	361.7268	367.0321	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	623.9416	596.7206	561.9952	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	127.9092	174.8354	145.0526	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling Cooled fraction	fc = cooled area / (4) = 1.0000 (105)											
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

# 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	31.9773	43.7089	36.2631	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													111.9493 (107)
Space cooling per m2													1.9849 (108)
Energy for space heating													29.6626 (99)
Energy for space cooling													1.9849 (108)
Total													31.6475 (109)
Target Fabric Energy Efficiency (TFEE)													36.4 (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	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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:												
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)			5.4400	1.3258	7.2121		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.1200	7.9600	26.1600	0.2500	6.5400	52.8000	1381.2480 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			54.3700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.0086		(33)
AAC Party Wall			24.9900	0.0000	0.0000	52.8000	1319.4720 (32)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 13155.4440 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							233.2526 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5734 (36)
Total fabric heat loss							(33) + (36) = 27.5821 (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	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413 (38)
Average = Sum(39)m / 12 =	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234 (39)
HLP	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834 (40)
HLP (average)												0.8834 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (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 =	1239.9620 (45)
Distribution loss (46)m = 0.15 x (45)m														
	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752	18.6752 (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	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156	14.0156 (61)	
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	138.5167 (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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	138.5167 (64)	
RHI water heating demand													Total per year (kWh/year) = Sum(64)m =	1404.3028 (64)
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005	44.9005 (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	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.0934	34.7225	28.2382	21.3781	15.9804	13.4913	14.5779	18.9489	25.4331	32.2932	37.6909	40.1800	40.1800 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.4559	246.9926	240.6002	226.9916	209.8132	193.6679	182.8819	180.3452	186.7376	200.3462	217.5246	233.6699	233.6699 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502	60.3502 (72)
Total internal gains	434.4278	430.7670	414.1014	388.4833	362.5633	339.2223	325.5243	332.4840	347.1833	372.9815	401.5758	422.9126	422.9126 (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								
Northeast	3.9900	12.9465	0.4300	0.0000	0.7700	17.1035 (75)							
Southwest	1.4500	40.9830	0.4300	0.0000	0.7700	19.6757 (79)							
Southwest	2.5200	40.9830	0.4300	0.0000	0.7700	34.1951 (79)							
Solar gains	70.9744	118.0344	172.7456	249.5228	291.2205	311.0919	292.9423	254.6442	206.6368	140.3387	88.1648	59.4819	59.4819 (83)
Total gains	505.4022	548.8014	586.8470	638.0061	653.7838	650.3142	618.4666	587.1282	553.8202	513.3202	489.7406	482.3945	482.3945 (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	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449
alpha	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897
util living area	0.9760	0.9605	0.9176	0.8052	0.6291	0.4274	0.2738	0.2884	0.5331	0.8230	0.9498	0.9806	0.9806 (86)
MIT	20.4090	20.5180	20.7052	20.8902	20.9774	20.9980	20.9999	20.9999	20.9932	20.8965	20.6340	20.3715	20.3715 (87)
Th 2	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816 (88)
util rest of house	0.9698	0.9508	0.8983	0.7675	0.5748	0.3657	0.2080	0.2191	0.4634	0.7788	0.9355	0.9754	0.9754 (89)
MIT 2	19.4183	19.5719	19.8299	20.0662	20.1628	20.1805	20.1816	20.1816	20.1774	20.0791	19.7372	19.3651	19.3651 (90)
Living area fraction													fLA = Living area / (4) =
MIT	19.7968	19.9334	20.1644	20.3810	20.4741	20.4929	20.4943	20.4942	20.4891	20.3914	20.0799	19.7497	19.7497 (92)
Temperature adjustment													0.0000
adjusted MIT	19.7968	19.9334	20.1644	20.3810	20.4741	20.4929	20.4943	20.4942	20.4891	20.3914	20.0799	19.7497	19.7497 (93)

#### 8. Space heating requirement

Utilisation	0.9663	0.9474	0.8979	0.7772	0.5946	0.3893	0.2331	0.2456	0.4899	0.7909	0.9335	0.9721	0.9721 (94)
Useful gains	488.3577	519.9365	526.9071	495.8301	388.7249	253.1373	144.1815	144.1735	271.2996	405.9611	457.1625	468.9434	468.9434 (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	752.1757	734.0685	655.8928	542.1301	397.2945	253.7440	144.2023	144.2014	273.4865	447.9830	616.8074	749.8252	749.8252 (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	196.2806	143.8967	95.9654	33.3360	6.3758	0.0000	0.0000	0.0000	0.0000	31.2642	114.9443	208.9761	208.9761 (98)
Space heating													831.0391 (98)
RHI space heating demand													831 (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 (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	2.3900 (2b)	134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	134.7960 (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:												
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)			5.4400	1.3258	7.2121		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.1200	7.9600	26.1600	0.2500	6.5400	52.8000	1381.2480 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			54.3700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	23.0086	(33)
AAC Party Wall			24.9900	0.0000	0.0000	52.8000	1319.4720 (32)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							13155.4440 (34)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							233.2526 (35)
Total fabric heat loss							(33) + (36) =
							27.5821 (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	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413 (38)
Average = Sum(39)m / 12 =	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234 (39)
HLP	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834 (40)
HLP (average)												0.8834 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (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 =	1239.9620 (45)
Distribution loss (46)m = 0.15 x (45)m														
	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752	18.6752 (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	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156	14.0156 (61)	
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	138.5167 (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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	138.5167 (64)	
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005	44.9005 (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	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.0934	34.7225	28.2382	21.3781	15.9804	13.4913	14.5779	18.9489	25.4331	32.2932	37.6909	40.1800	40.1800 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.4559	246.9926	240.6002	226.9916	209.8132	193.6679	182.8819	180.3452	186.7376	200.3462	217.5246	233.6699	233.6699 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502	60.3502 (72)
Total internal gains	434.4278	430.7670	414.1014	388.4833	362.5633	339.2223	325.5243	332.4840	347.1833	372.9815	401.5758	422.9126	422.9126 (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							
Northeast	3.9900	11.2829	0.4300	0.0000	0.7700	14.9058 (75)							
Southwest	1.4500	36.7938	0.4300	0.0000	0.7700	17.6645 (79)							
Southwest	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997 (79)							
Solar gains	63.2700	112.7234	167.3841	229.4400	277.1119	283.9580	270.0828	233.1645	188.6611	128.1292	76.6846	53.5625	53.5625 (83)
Total gains	497.6979	543.4904	581.4855	617.9233	639.6752	623.1803	595.6071	565.6485	535.8444	501.1107	478.2604	476.4752	476.4752 (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	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449
alpha	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897
util living area	0.9799	0.9650	0.9300	0.8441	0.6908	0.5068	0.3674	0.4040	0.6239	0.8688	0.9621	0.9841	0.9841 (86)
MIT	20.3618	20.4854	20.6633	20.8494	20.9603	20.9944	20.9993	20.9988	20.9825	20.8465	20.5693	20.3177	20.3177 (87)
Th 2	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816 (88)
util rest of house	0.9748	0.9564	0.9134	0.8115	0.6399	0.4441	0.2994	0.3328	0.5568	0.8333	0.9512	0.9799	0.9799 (89)
MIT 2	19.3507	19.5259	19.7730	20.0170	20.1457	20.1780	20.1814	20.1811	20.1689	20.0193	19.6473	19.2876	19.2876 (90)
Living area fraction	19.7370	19.8925	20.1132	20.3350	20.4569	20.4899	20.4939	20.4935	20.4798	20.3354	19.9996	19.6812	19.6812 (92)
Temperature adjustment	19.7370	19.8925	20.1132	20.3350	20.4569	20.4899	20.4939	20.4935	20.4798	20.3354	19.9996	19.6812	19.6812 (93)
adjusted MIT	19.7370	19.8925	20.1132	20.3350	20.4569	20.4899	20.4939	20.4935	20.4798	20.3354	19.9996	19.6812	19.6812 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	483.4582	517.8779	530.2314	505.4484	420.6077	291.6067	193.8295	203.6326	311.7260	421.2183	453.5710	465.4009	465.4009 (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	4.2000 (96)	
Heat loss rate W	769.1251	746.9784	678.2553	569.7312	436.3003	293.4567	194.0064	203.9536	317.8623	485.0499	642.7010	771.3259	771.3259 (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	1.0000 (97a)	
Space heating kWh	212.5362	153.9556	110.1298	46.2836	11.6753	0.0000	0.0000	0.0000	0.0000	47.4907	136.1736	227.6082	227.6082 (98)	
Space heating													945.8530 (98)	
Space heating per m2													(98) / (4) =	16.7704 (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

	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													1011.6075 (211)
Space heating requirement	212.5362	153.9556	110.1298	46.2836	11.6753	0.0000	0.0000	0.0000	0.0000	47.4907	136.1736	227.6082	(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)	227.3114	164.6584	117.7859	49.5012	12.4870	0.0000	0.0000	0.0000	0.0000	50.7922	145.6402	243.4312	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Efficiency of water heater (217)m	89.1874	89.0370	88.7390	88.1969	87.5948	87.3000	87.3000	87.3000	87.3000	88.1895	88.9195	89.2621	(217)
Fuel for water heating, kWh/month	159.8674	140.4899	146.5033	129.9976	126.7066	111.3518	104.8107	117.9550	118.6751	134.9247	144.1656	155.1797	(219)
Water heating fuel used													1590.6274 (219)
Annual totals kWh/year													
Space heating fuel - main system													1011.6075 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9550, total flow = 29.0000, SFP = 0.2398)													
mechanical ventilation fans (SFP = 0.2398)													39.4399 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													114.4399 (231)
Electricity for lighting (calculated in Appendix L)													276.1610 (232)
Total delivered energy for all uses													2992.8357 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1011.6075	3.4800	35.2039 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1590.6274	3.4800	55.3538 (247)
Mechanical ventilation fans	39.4399	13.1900	5.2021 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	276.1610	13.1900	36.4256 (250)
Additional standing charges			120.0000 (251)
Total energy cost			262.0780 (255)

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

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.0855 (257)
SAP value		84.8569
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	1011.6075	0.2160	218.5072 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1590.6274	0.2160	343.5755 (264)
Space and water heating			562.0827 (265)
Pumps and fans	114.4399	0.5190	59.3943 (267)
Energy for lighting	276.1610	0.5190	143.3275 (268)
Total kg/year			764.8046 (272)
CO2 emissions per m2			13.5600 (273)
EI value			89.8931
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	$3.48 / 0.8819 = 3.946$ , stars = 4
Water heating environmental impact	$0.216 / 0.8819 = 0.2449$ , 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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:												
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)			5.4400	1.3258	7.2121		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.1200	7.9600	26.1600	0.2500	6.5400	52.8000	1381.2480 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			54.3700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.0086		(33)
AAC Party Wall			24.9900	0.0000	0.0000	52.8000	1319.4720 (32)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 13155.4440 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							233.2526 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5734 (36)
Total fabric heat loss							(33) + (36) = 27.5821 (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	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413 (38)
Average = Sum(39)m / 12 =	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234	49.8234 (39)
HLP	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834	0.8834 (40)
HLP (average)												0.8834 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (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 =	1239.9620 (45)
Distribution loss (46)m = 0.15 x (45)m													
	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752	(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	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156	(61)
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005	(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	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.0934	34.7225	28.2382	21.3781	15.9804	13.4913	14.5779	18.9489	25.4331	32.2932	37.6909	40.1800	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.4559	246.9926	240.6002	226.9916	209.8132	193.6679	182.8819	180.3452	186.7376	200.3462	217.5246	233.6699	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	(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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	(71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502	(72)
Total internal gains	434.4278	430.7670	414.1014	388.4833	362.5633	339.2223	325.5243	332.4840	347.1833	372.9815	401.5758	422.9126	(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							
Northeast	3.9900	12.9465	0.4300	0.0000	0.7700	17.1035	(75)						
Southwest	1.4500	40.9830	0.4300	0.0000	0.7700	19.6757	(79)						
Southwest	2.5200	40.9830	0.4300	0.0000	0.7700	34.1951	(79)						
Solar gains	70.9744	118.0344	172.7456	249.5228	291.2205	311.0919	292.9423	254.6442	206.6368	140.3387	88.1648	59.4819	(83)
Total gains	505.4022	548.8014	586.8470	638.0061	653.7838	650.3142	618.4666	587.1282	553.8202	513.3202	489.7406	482.3945	(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	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	73.3449	
alpha	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	5.8897	
util living area	0.9760	0.9605	0.9176	0.8052	0.6291	0.4274	0.2738	0.2884	0.5331	0.8230	0.9498	0.9806	(86)
MIT	20.4090	20.5180	20.7052	20.8902	20.9774	20.9980	20.9999	20.9999	20.9932	20.8965	20.6340	20.3715	(87)
Th 2	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	20.1816	(88)
util rest of house	0.9698	0.9508	0.8983	0.7675	0.5748	0.3657	0.2080	0.2191	0.4634	0.7788	0.9355	0.9754	(89)
MIT 2	19.4183	19.5719	19.8299	20.0662	20.1628	20.1805	20.1816	20.1816	20.1774	20.0791	19.7372	19.3651	(90)
Living area fraction	19.7968	19.9334	20.1644	20.3810	20.4741	20.4929	20.4943	20.4942	fLA = Living area / (4) =	20.4891	20.3914	20.0799	0.3821 (91)
MIT	19.7968	19.9334	20.1644	20.3810	20.4741	20.4929	20.4943	20.4942	20.4891	20.3914	20.0799	19.7497	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7968	19.9334	20.1644	20.3810	20.4741	20.4929	20.4943	20.4942	20.4891	20.3914	20.0799	19.7497	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	488.3577	519.9365	526.9071	495.8301	388.7249	253.1373	144.1815	144.1735	271.2996	405.9611	457.1625	468.9434	(94)
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	752.1757	734.0685	655.8928	542.1301	397.2945	253.7440	144.2023	144.2014	273.4865	447.9830	616.8074	749.8252	(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	196.2806	143.8967	95.9654	33.3360	6.3758	0.0000	0.0000	0.0000	0.0000	31.2642	114.9443	208.9761	(98)
Space heating												831.0391	(98)
Space heating per m2												(98) / (4) =	14.7347 (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													888.8119 (211)
Space heating requirement	196.2806	143.8967	95.9654	33.3360	6.3758	0.0000	0.0000	0.0000	0.0000	31.2642	114.9443	208.9761	(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)	209.9258	153.9003	102.6368	35.6535	6.8190	0.0000	0.0000	0.0000	0.0000	33.4377	122.9350	223.5038	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Efficiency of water heater (217)m	89.1254	88.9832	88.6309	88.0009	87.4680	87.3000	87.3000	87.3000	87.3000	87.9471	88.7841	89.1967	(216)
Fuel for water heating, kWh/month	159.9786	140.5748	146.6820	130.2871	126.8902	111.3518	104.8107	117.9550	118.6751	135.2967	144.3855	155.2935	(219)
Water heating fuel used													1592.1810 (219)
Annual totals kWh/year													
Space heating fuel - main system													888.8119 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9550, total flow = 29.0000, SFP = 0.2398)													
mechanical ventilation fans (SFP = 0.2398)													39.4399 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													114.4399 (231)
Electricity for lighting (calculated in Appendix L)													276.1610 (232)
Total delivered energy for all uses													2871.5937 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	888.8119	3.9200	34.8414 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1592.1810	3.9200	62.4135 (247)
Mechanical ventilation fans	39.4399	16.9600	6.6890 (249)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	276.1610	16.9600	46.8369 (250)
Additional standing charges			88.0000 (251)
Total energy cost			251.5008 (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	888.8119	0.2160	191.9834 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1592.1810	0.2160	343.9111 (264)
Space and water heating			535.8945 (265)
Pumps and fans	114.4399	0.5190	59.3943 (267)
Energy for lighting	276.1610	0.5190	143.3275 (268)
Total kg/year			738.6163 (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	888.8119	1.2200	1084.3505 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1592.1810	1.2200	1942.4608 (264)
Space and water heating			3026.8113 (265)
Pumps and fans	114.4399	3.0700	351.3305 (267)
Energy for lighting	276.1610	3.0700	847.8142 (268)
Primary energy kWh/year			4225.9560 (272)
Primary energy kWh/m2/year			74.9283 (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 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:	SAP change	Cost change	CO2 change
(none)			

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 85  
 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	£66	£66	£0
Mains gas	£185	£185	£0
Space heating	£142	£142	£0
Water heating	£62	£62	£0
Lighting	£47	£47	£0
Total cost of fuels	£251	£251	£0
Total cost of uses	£251	£251	£0
Delivered energy	51 kWh/m <sup>2</sup>	51 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>	13 kg/m <sup>2</sup>	13 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	75 kWh/m <sup>2</sup>	75 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	233.3 (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	266.90 (P1)
Transmission heat loss coefficient	27.58 (37)
Summer heat loss coefficient	294.48 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North East	1.000	0.90	1.000	0.900 (P8)
South 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
North East	3.9900	100.0415	0.4300	0.0000	0.9000	154.4770
South West	1.4500	122.3147	0.4300	0.0000	0.9000	68.6369
South West	2.5200	122.3147	0.4300	0.0000	0.9000	119.2862

total: 342.4001

	Jun	Jul	Aug	
Solar gains	364	342	298	(P4)
Internal gains	336	323	329	
Total summer gains	700	665	627	(P5)

	2.38	2.26	2.13	(P6)
Summer gain/loss ratio				
Summer external temperature	15.40	17.60	17.60	
Thermal mass temperature increment (TMP = 233.3)	0.37	0.37	0.37	
Threshold temperature	18.14	20.23	20.10	(P7)

Likelihood of high internal temperature	Not significant	Not significant	Not significant
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Assessment of likelihood of high internal temperature: Not significant