

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on 16 July 2019 at 15:44:29

Project Information:

Assessed By: Gerard Mcguigan (STRO011196)

Building Type: Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 107.2m²

Site Reference : Hedgerows Westgate

Plot Reference: Plot 108

Address : Plot 108, The Hedgerows, Westergate, PO20

Client Details:

Name: Taylor Wimpey Southern Counties

Address : Colvedene Court, Wessex Business Park, Colden Common, Hampshire, SO21 1WP

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.54 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 17.04 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.7 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 49.9 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.39 (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	7.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 444, product index 017929): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 35 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

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5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls TTZC by plumbing and electrical services OK

Hot water controls: No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0% OK

8 Mechanical ventilation

Continuous extract system (decentralised)

Specific fan power: 0.16 0.18

Maximum 0.7 OK

9 Summer time temperatures

Overheating risk (South England): Slight OK

Based on:

Overshading: Average or unknown

Windows facing: South 5.35m²

Windows facing: North 6.9m²

Ventilation rate: 4.00

Blinds/curtains: None

10 Key features

Thermal bridging 0.031 W/m²K

Roofs U-value 0.11 W/m²K

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Gerard Mcguigan **Stroma Number:** STRO011196
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.18

Property Address: Plot 108

Address : Plot 108, The Hedgerows, Westergate, PO20

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	53.6	(1a) x	2.3	(2a) =	123.28 (3a)
First floor	53.6	(1b) x	2.6	(2b) =	139.36 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.2	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	262.64 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			7 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.35 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.3 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.33	0.35
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0.63	0.62	0.61	0.58	0.57	0.53	0.53	0.53	0.55	0.57	0.58	0.6
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(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.61	0.58	0.57	0.53	0.53	0.53	0.55	0.57	0.58	0.6
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(25)

3. Thermal losses and heat capacity parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.1	1.3	2.73		(26)
Windows Type 1			5.35	$\times 1/[1/(1.4) + 0.04]$	7.09		(27)
Windows Type 2			6.9	$\times 1/[1/(1.4) + 0.04]$	9.15		(27)
Floor			53.6	0.15	8.04	75	4020 (28)
Walls	147.49	14.35	133.14	0.25	33.29	60	7988.4 (29)
Roof	53.6	0	53.6	0.11	5.9	9	482.4 (30)
Total area of elements, m²			254.69				(31)
Internal wall **			161.3			9	1451.7 (32c)
Internal floor			53.6			18	964.8 (32d)
Internal ceiling			53.6			9	482.4 (32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 66.19 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 15389.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 143.56 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8 (36)

SAP WorkSheet: New dwelling design stage

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 74.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	54.54	53.9	53.25	50.03	49.39	46.16	46.16	45.52	47.45	49.39	50.68	51.96	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	128.73	128.09	127.44	124.22	123.58	120.35	120.35	119.71	121.64	123.58	124.87	126.16	
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Average = Sum(39)_{1...12} / 12 = 124.06 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.19	1.19	1.16	1.15	1.12	1.12	1.12	1.13	1.15	1.16	1.18	
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Average = Sum(40)_{1...12} / 12 = 1.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement kWh/year

Assumed occupancy, N 2.8 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.63 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	110.69	106.66	102.64	98.61	94.59	90.56	90.56	94.59	98.61	102.64	106.66	110.69	
Total = Sum(44) _{1...12} =												1207.53	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	164.15	143.57	148.15	129.16	123.93	106.94	99.1	113.72	115.08	134.11	146.39	158.97	
Total = Sum(45) _{1...12} =												1583.26	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.12	21.96	23.85	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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Water storage loss calculated for each month

$$\{(56)\}m = \{(55)\} \times \{(41)\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	{56}
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If cylinder contains dedicated solar storage, $\{(57)\}m = \{(56)\}m \times [(\{(50)\}) - (H11)] \div \{(50)\}$, else $\{(57)\}m = \{(56)\}m$ where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	{57}
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Primary circuit loss (annual) from Table 3

0

{58}

Primary circuit loss calculated for each month $\{(59)\}m = \{(58)\} \div 365 \times \{(41)\}m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

{59}m=	0	0	0	0	0	0	0	0	0	0	0	{59}
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Combi loss calculated for each month $\{(61)\}m = \{(60)\} \div 365 \times \{(41)\}m$

{61}m=	14.15	12.77	14.11	13.62	14.04	13.55	13.97	14.01	13.59	14.08	13.66	14.14	{61}
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Total heat required for water heating calculated for each month $\{(62)\}m = 0.85 \times \{(45)\}m + \{(46)\}m + \{(57)\}m + \{(59)\}m + \{(61)\}m$

{62}m=	178.3	156.34	162.26	142.78	137.97	120.49	113.07	127.73	128.66	148.19	160.05	173.11	{62}
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

{63}m=	0	0	0	0	0	0	0	0	0	0	0	{63}
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Output from water heater

{64}m=	178.3	156.34	162.26	142.78	137.97	120.49	113.07	127.73	128.66	148.19	160.05	173.11	
Output from water heater (annual) $\{(64)\}$												1748.94	{64}

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times \{(45)\}m + \{(61)\}m] + 0.8 \times [(\{(46)\}m + \{(57)\}m + \{(59)\}m)]$

{65}m=	58.12	50.93	52.79	46.35	44.72	38.94	36.44	41.31	41.66	48.11	52.09	56.39	{65}
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include $\{(57)\}m$ in calculation of $\{(65)\}m$ only if cylinder is in the dwelling or hot water is from community heating

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=	167.82	167.82	167.82	167.82	167.82	167.82	167.82	167.82	167.82	167.82	167.82	167.82	{66}

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

{67}m=	66.89	59.41	48.31	36.58	27.34	23.08	24.94	32.42	43.51	55.25	64.49	68.74	{67}
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

{68}m=	399.21	403.35	392.91	370.69	342.64	316.27	298.66	294.51	304.95	327.18	355.23	381.59	{68}
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

{69}m=	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	{69}
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Pumps and fans gains (Table 5a)

{70}m=	3	3	3	3	3	3	3	3	3	3	3	3	{70}
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Losses e.g. evaporation (negative values) (Table 5)

{71}m=	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	{71}
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Water heating gains (Table 5)

{72}m=	78.11	75.79	70.95	64.37	60.1	54.09	48.98	55.53	57.86	64.67	72.35	75.8	{72}
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Total internal gains =

$$\{(66)\}m + \{(67)\}m + \{(68)\}m + \{(69)\}m + \{(70)\}m + \{(71)\}m + \{(72)\}m$$

{73}m=	657.73	652.06	625.69	585.16	543.6	506.96	486.1	495.98	519.84	560.61	605.58	639.65	{73}
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6 Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

SAP WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.9	x	10.63	x	0.45	x	1.11	=	25.42	{74}
North	0.9x	0.77	x	6.9	x	20.32	x	0.45	x	1.11	=	48.58	{74}
North	0.9x	0.77	x	6.9	x	34.53	x	0.45	x	1.11	=	82.56	{74}
North	0.9x	0.77	x	6.9	x	55.46	x	0.45	x	1.11	=	132.61	{74}
North	0.9x	0.77	x	6.9	x	74.72	x	0.45	x	1.11	=	178.63	{74}
North	0.9x	0.77	x	6.9	x	79.99	x	0.45	x	1.11	=	191.23	{74}
North	0.9x	0.77	x	6.9	x	74.68	x	0.45	x	1.11	=	178.54	{74}
North	0.9x	0.77	x	6.9	x	59.25	x	0.45	x	1.11	=	141.65	{74}
North	0.9x	0.77	x	6.9	x	41.52	x	0.45	x	1.11	=	99.26	{74}
North	0.9x	0.77	x	6.9	x	24.19	x	0.45	x	1.11	=	57.83	{74}
North	0.9x	0.77	x	6.9	x	13.12	x	0.45	x	1.11	=	31.36	{74}
North	0.9x	0.77	x	6.9	x	8.86	x	0.45	x	1.11	=	21.19	{74}
South	0.9x	0.77	x	5.35	x	46.75	x	0.45	x	1.11	=	86.67	{78}
South	0.9x	0.77	x	5.35	x	76.57	x	0.45	x	1.11	=	141.94	{78}
South	0.9x	0.77	x	5.35	x	97.53	x	0.45	x	1.11	=	180.81	{78}
South	0.9x	0.77	x	5.35	x	110.23	x	0.45	x	1.11	=	204.35	{78}
South	0.9x	0.77	x	5.35	x	114.87	x	0.45	x	1.11	=	212.95	{78}
South	0.9x	0.77	x	5.35	x	110.55	x	0.45	x	1.11	=	204.93	{78}
South	0.9x	0.77	x	5.35	x	108.01	x	0.45	x	1.11	=	200.23	{78}
South	0.9x	0.77	x	5.35	x	104.89	x	0.45	x	1.11	=	194.45	{78}
South	0.9x	0.77	x	5.35	x	101.89	x	0.45	x	1.11	=	188.87	{78}
South	0.9x	0.77	x	5.35	x	82.59	x	0.45	x	1.11	=	153.1	{78}
South	0.9x	0.77	x	5.35	x	55.42	x	0.45	x	1.11	=	102.73	{78}
South	0.9x	0.77	x	5.35	x	40.4	x	0.45	x	1.11	=	74.89	{78}

Solar gains in watts, calculated for each month

{83}m = Sum(74)m ... (82)m

{83}m=	112.09	190.52	263.36	336.96	391.58	396.16	378.77	336.1	288.13	210.93	134.09	96.08	{83}
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Total gains – internal and solar {84}m = {73}m + {83}m , watts

{84}m=	769.82	842.59	889.06	922.11	935.18	903.12	864.87	832.08	807.98	771.54	739.67	735.74	{84}
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 {85}

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
{86}m=	0.98	0.97	0.95	0.91	0.84	0.71	0.56	0.6	0.78	0.92	0.96	0.98	{86}

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

{87}m=	19.18	19.37	19.69	20.13	20.52	20.82	20.94	20.93	20.73	20.24	19.66	19.17	{87}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

{88}m=	19.92	19.92	19.93	19.95	19.96	19.98	19.98	19.99	19.97	19.96	19.95	19.94	{88}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

{89}m=	0.97	0.96	0.94	0.89	0.8	0.63	0.45	0.49	0.72	0.89	0.96	0.97	{89}
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SAP WorkSheet: New dwelling design stage

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.51	17.79	18.25	18.89	19.43	19.83	19.95	19.94	19.72	19.06	18.22	17.5	(90)
fLA = Living area ÷ (4) =													(91)
											0.16		

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.77	18.04	18.48	19.09	19.6	19.99	20.1	20.1	19.87	19.24	18.45	17.77	(92)
--------	-------	-------	-------	-------	------	-------	------	------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.62	17.89	18.33	18.94	19.45	19.84	19.95	19.95	19.72	19.09	18.3	17.62	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

9. Space heating calculation

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.92	0.87	0.78	0.62	0.45	0.48	0.7	0.87	0.94	0.96	(94)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	736.35	793.48	815.1	799.68	726.63	558.7	386.56	402	567.32	670.89	693.55	707.39	(95)
--------	--------	--------	-------	--------	--------	-------	--------	-----	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m – (96)m)]

(97)m=	1715.14	1664.03	1507.29	1246.67	958.13	630.27	403.71	424.57	684.23	1049.48	1398.03	1692.45	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	---------	---------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	728.22	585.01	514.99	321.83	172.24	0	0	0	0	281.67	507.22	732.89	(98)
Total per year (kWh/year) = Sum(98)1...12 =													(99)
											3844.07		

Space heating requirement in kWh/m²/year

35.86 (99)

9a. Energy requirements for individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

728.22	585.01	514.99	321.83	172.24	0	0	0	0	281.67	507.22	732.89
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = {[(98)m x (204)]} x 100 ÷ (206) (211)

804.67	646.42	569.05	355.61	190.32	0	0	0	0	311.23	560.47	809.82
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)1...12 = 4247.59 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)]} x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

178.3	156.34	162.26	142.78	137.97	120.49	113.07	127.73	128.66	148.19	160.05	173.11
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Efficiency of water heater 87.3 (216)

SAP WorkSheet: New dwelling design stage

(217)m=	89.85	89.81	89.71	89.49	89.05	87.3	87.3	87.3	87.3	89.37	89.71	89.87	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	198.44	174.08	180.87	159.54	154.94	138.02	129.52	146.31	147.38	165.81	178.41	192.62	
Total = Sum(219a)_{1..12} =												1965.94	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

69.35 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 144.35 (231)

Electricity for lighting

472.49 (232)

10a Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.48	x 0.01 = 147.82 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 = 68.41 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 19.04 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19	x 0.01 = 62.32 (250)
Additional standing charges (Table 12)			120 (251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)...(254) = 417.59 (255)

11a SAP rating - individual heating systems

Energy cost deflator (Table 12)	0.42 (256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] = 1.15 (257)
SAP rating (Section 12)	83.92 (258)

12a CO2 emissions - individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	= 917.48 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 424.64 (264)

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Space and water heating	{261} + {262} + {263} + {264} =			1342.12	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	=	74.92	{267}
Electricity for lighting	{232} x	0.519	=	245.22	{268}
Total CO2, kg/year	sum of {265} .. {271} =			1662.26	{272}
CO2 emissions per m²	{272} ÷ {4} =			15.51	{273}
El rating (section 14)				85	{274}

1.3a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	{211} x	1.22	=	5182.06	{261}
Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	1.22	=	2398.44	{264}
Space and water heating	{261} + {262} + {263} + {264} =			7580.5	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	443.15	{267}
Electricity for lighting	{232} x	0	=	1450.55	{268}
'Total Primary Energy	sum of {265}...{271} =			9474.2	{272}
Primary energy kWh/m²/year	{272} ÷ {4} =			88.38	{273}

DFEE WorkSheet: New dwelling design stage

User Details

Assessor Name: Gerard Mcguigan
Software Name: Stroma FSAP 2012

Stroma Number: STRO011196
Software Version: Version: 1.0.4.18

Property Address: Plot 108

Address : Plot 108, The Hedgerows, Westergate, PO20

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	53.6	(1a) x	2.3	(2a) =	123.28 (3a)
First floor	53.6	(1b) x	2.6	(2b) =	139.36 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.2	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	262.64 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							4	x 10 =	40 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.15 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			7 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.5 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.43 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.54	0.53	0.52	0.47	0.46	0.41	0.41	0.39	0.43	0.46	0.48	0.5
--	------	------	------	------	------	------	------	------	------	------	------	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0.65	0.64	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.65	0.64	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
--------	------	------	------	------	------	------	------	------	------	------	------	------

3. Thermal losses and heat capacity parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.1	1.3	2.73		(26)
Windows Type 1			5.35	$\times 1/[1/(1.4) + 0.04]$	7.09		(27)
Windows Type 2			6.9	$\times 1/[1/(1.4) + 0.04]$	9.15		(27)
Floor			53.6	0.15	8.04	75	4020 (28)
Walls	147.49	14.35	133.14	0.25	33.29	60	7988.4 (29)
Roof	53.6	0	53.6	0.11	5.9	9	482.4 (30)
Total area of elements, m ²			254.69				(31)
Internal wall **			161.3			9	1451.7 (32c)
Internal floor			53.6			18	964.8 (32d)
Internal ceiling			53.6			9	482.4 (32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 66.19 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 15389.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 143.56 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

74.19

(37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	56.18	55.68	55.19	52.89	52.46	50.47	50.47	50.09	51.24	52.46	53.33	54.24

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

(39)m=	130.37	129.87	129.38	127.09	126.66	124.66	124.66	124.29	125.43	126.66	127.52	128.43
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Average = Sum(39)_{1...12} / 12 =

127.08

(39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.22	1.21	1.21	1.19	1.18	1.16	1.16	1.16	1.17	1.18	1.19	1.2
--------	------	------	------	------	------	------	------	------	------	------	------	-----

Average = Sum(40)_{1...12} / 12 =

1.19

(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

2.8

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

100.63

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	110.69	106.66	102.64	98.61	94.59	90.56	90.56	94.59	98.61	102.64	106.66	110.69
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	--------	--------	--------

Total = Sum(44)_{1...12} =

1207.53

(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	164.15	143.57	148.15	129.16	123.93	106.94	99.1	113.72	115.08	134.11	146.39	158.97
--------	--------	--------	--------	--------	--------	--------	------	--------	--------	--------	--------	--------

Total = Sum(45)_{1...12} =

1583.26

(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

0

(54)

Enter (50) or (54) in (55)

0

(55)

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Water storage loss calculated for each month

$$\{(56)\}m = \{(55)\} \times \{(41)\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	{56}
--------	---	---	---	---	---	---	---	---	---	---	---	------

If cylinder contains dedicated solar storage, $\{(57)\}m = \{(56)\}m \times [(\{(50)\} - (H11)) \div \{(50)\}]$, else $\{(57)\}m = \{(56)\}m$ where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	{57}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Primary circuit loss (annual) from Table 3

0	{58}
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Primary circuit loss calculated for each month $\{(59)\}m = \{(58)\} \div 365 \times \{(41)\}m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

{59}m=	0	0	0	0	0	0	0	0	0	0	0	{59}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Combi loss calculated for each month $\{(61)\}m = \{(60)\} \div 365 \times \{(41)\}m$

{61}m=	0	0	0	0	0	0	0	0	0	0	0	{61}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month $\{(62)\}m = 0.85 \times \{(45)\}m + \{(46)\}m + \{(57)\}m + \{(59)\}m + \{(61)\}m$

{62}m=	139.53	122.03	125.93	109.79	105.34	90.9	84.23	96.66	97.81	113.99	124.43	135.12	{62}
--------	--------	--------	--------	--------	--------	------	-------	-------	-------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

{63}m=	0	0	0	0	0	0	0	0	0	0	0	{63}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

{64}m=	139.53	122.03	125.93	109.79	105.34	90.9	84.23	96.66	97.81	113.99	124.43	135.12	
Output from water heater (annual) $\{(64)\}$												1345.77	{64}

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times \{(45)\}m + \{(61)\}m] + 0.8 \times [(\{(46)\}m + \{(57)\}m + \{(59)\}m)]$

{65}m=	34.88	30.51	31.48	27.45	26.34	22.73	21.06	24.16	24.45	28.5	31.11	33.78	{65}
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include $\{(57)\}m$ in calculation of $\{(65)\}m$ only if cylinder is in the dwelling or hot water is from community heating

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=	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	{66}

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

{67}m=	26.75	23.76	19.33	14.63	10.94	9.23	9.98	12.97	17.41	22.1	25.79	27.5	{67}
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

{68}m=	267.47	270.25	263.25	248.36	229.57	211.9	200.1	197.32	204.32	219.21	238	255.67	{68}
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

{69}m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	{69}
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Pumps and fans gains (Table 5a)

{70}m=	0	0	0	0	0	0	0	0	0	0	0	0	{70}
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Losses e.g. evaporation (negative values) (Table 5)

{71}m=	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	{71}
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Water heating gains (Table 5)

{72}m=	46.88	45.4	42.31	38.12	35.4	31.56	28.3	32.48	33.96	38.3	43.21	45.4	{72}
--------	-------	------	-------	-------	------	-------	------	-------	-------	------	-------	------	------

Total internal gains = $\{(66)\}m + \{(67)\}m + \{(68)\}m + \{(69)\}m + \{(70)\}m + \{(71)\}m + \{(72)\}m$

{73}m=	406.06	404.36	389.84	366.07	340.85	317.65	303.33	307.73	320.64	344.57	371.96	393.53	{73}
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6 Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DFEE WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.9	x	10.63	x	0.45	x	1.11	=	25.42	(74)
North	0.9x	0.77	x	6.9	x	20.32	x	0.45	x	1.11	=	48.58	(74)
North	0.9x	0.77	x	6.9	x	34.53	x	0.45	x	1.11	=	82.56	(74)
North	0.9x	0.77	x	6.9	x	55.46	x	0.45	x	1.11	=	132.61	(74)
North	0.9x	0.77	x	6.9	x	74.72	x	0.45	x	1.11	=	178.63	(74)
North	0.9x	0.77	x	6.9	x	79.99	x	0.45	x	1.11	=	191.23	(74)
North	0.9x	0.77	x	6.9	x	74.68	x	0.45	x	1.11	=	178.54	(74)
North	0.9x	0.77	x	6.9	x	59.25	x	0.45	x	1.11	=	141.65	(74)
North	0.9x	0.77	x	6.9	x	41.52	x	0.45	x	1.11	=	99.26	(74)
North	0.9x	0.77	x	6.9	x	24.19	x	0.45	x	1.11	=	57.83	(74)
North	0.9x	0.77	x	6.9	x	13.12	x	0.45	x	1.11	=	31.36	(74)
North	0.9x	0.77	x	6.9	x	8.86	x	0.45	x	1.11	=	21.19	(74)
South	0.9x	0.77	x	5.35	x	46.75	x	0.45	x	1.11	=	86.67	(78)
South	0.9x	0.77	x	5.35	x	76.57	x	0.45	x	1.11	=	141.94	(78)
South	0.9x	0.77	x	5.35	x	97.53	x	0.45	x	1.11	=	180.81	(78)
South	0.9x	0.77	x	5.35	x	110.23	x	0.45	x	1.11	=	204.35	(78)
South	0.9x	0.77	x	5.35	x	114.87	x	0.45	x	1.11	=	212.95	(78)
South	0.9x	0.77	x	5.35	x	110.55	x	0.45	x	1.11	=	204.93	(78)
South	0.9x	0.77	x	5.35	x	108.01	x	0.45	x	1.11	=	200.23	(78)
South	0.9x	0.77	x	5.35	x	104.89	x	0.45	x	1.11	=	194.45	(78)
South	0.9x	0.77	x	5.35	x	101.89	x	0.45	x	1.11	=	188.87	(78)
South	0.9x	0.77	x	5.35	x	82.59	x	0.45	x	1.11	=	153.1	(78)
South	0.9x	0.77	x	5.35	x	55.42	x	0.45	x	1.11	=	102.73	(78)
South	0.9x	0.77	x	5.35	x	40.4	x	0.45	x	1.11	=	74.89	(78)

Solar gains in watts, calculated for each month

{83}m = Sum{74}m ... {82}m

{83}m=	112.09	190.52	263.36	336.96	391.58	396.16	378.77	336.1	288.13	210.93	134.09	96.08	{83}
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Total gains – internal and solar {84}m = {73}m + {83}m , watts

{84}m=	518.15	594.89	653.21	703.02	732.43	713.81	682.1	643.83	608.77	555.49	506.05	489.61	{84}
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 {85}

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
{86}m=	0.99	0.99	0.98	0.96	0.91	0.81	0.68	0.72	0.88	0.96	0.99	0.99	{86}

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

{87}m=	18.84	19.05	19.39	19.87	20.33	20.71	20.89	20.86	20.57	19.98	19.34	18.82	{87}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

{88}m=	19.91	19.91	19.91	19.93	19.93	19.95	19.95	19.95	19.94	19.93	19.93	19.92	{88}
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

{89}m=	0.99	0.98	0.97	0.94	0.88	0.74	0.56	0.61	0.83	0.95	0.98	0.99	{89}
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.93	18.14	18.48	18.97	19.41	19.77	19.9	19.89	19.65	19.08	18.44	17.92	(90)
fLA = Living area ÷ (4) =												0.16	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.08	18.28	18.63	19.11	19.56	19.92	20.06	20.04	19.79	19.22	18.58	18.06	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.08	18.28	18.63	19.11	19.56	19.92	20.06	20.04	19.79	19.22	18.58	18.06	(93)
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9. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.93	0.87	0.74	0.57	0.62	0.82	0.94	0.98	0.99	(94)
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Useful gains, hmGm, W = (94)m × (84)m

(95)m=	511.09	582	629.58	655.3	634.36	526.38	390.13	398.44	500.93	523.33	495.28	484.02	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m × ((93)m – (96)m)]

(97)m=	1796.1	1738	1568.95	1297.29	995.03	662.64	430.9	452.38	713.83	1091.91	1464.38	1780.67	(97)
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Space heating requirement for each month, kWh/month = 0.024 × [(97)m – (95)m] × (41)m

(98)m=	956.04	776.83	698.9	462.23	268.34	0	0	0	0	423.02	697.75	964.71	
Total per year (kWh/year) = Sum(98) =												5247.82	(98)

Space heating requirement in kWh/m²/year

48.95 (99)

9. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	1171.77	922.45	944.57	0	0	0	0	(100)
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Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.68	0.76	0.73	0	0	0	0	(101)
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Useful loss, hmLm (Watts) = (100)m × (101)m

(102)m=	0	0	0	0	0	794.95	700.49	690.68	0	0	0	0	(102)
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Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	944.48	905.14	862.77	0	0	0	0	(103)
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Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 × [(103)m – (102)m] × (41)m

set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	107.66	152.26	128.04	0	0	0	0	
Total = Sum(104) =												387.96	(104)
Cooled fraction f C = cooled area ÷ (4) =												1	(105)

Intermittency factor (Table 10b)

(105)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(105) =												0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	26.92	38.06	32.01	0	0	0	0	
Total = Sum(107) =												96.99	(107)

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Space cooling requirement in kWh/m ² /year	(107) ÷ (4) =	0.9	(108)
91 Fabric Energy Efficiency, calculated only under special conditions, see section 1.5			
Fabric Energy Efficiency	(99) + (108) =	49.86	(109)

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Gerard Mcguigan
Software Name: Stroma FSAP 2012

Stroma Number: STRO011196
Software Version: Version: 1.0.4.18

Property Address: Plot 108

Address : Plot 108, The Hedgerows, Westergate, PO20

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	53.6	(1a) x	2.3	(2a) =	123.28 (3a)
First floor	53.6	(1b) x	2.6	(2b) =	139.36 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.2	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	262.64 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			7 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.35 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.3 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.33	0.35
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b) 0.5

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0.63	0.62	0.61	0.58	0.57	0.53	0.53	0.53	0.55	0.57	0.58	0.6
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(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.61	0.58	0.57	0.53	0.53	0.53	0.55	0.57	0.58	0.6
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(25)

3. Thermal losses and heat capacity parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.1	1.3	2.73		(26)
Windows Type 1			5.35	$\times 1/[1/(1.4) + 0.04]$	7.09		(27)
Windows Type 2			6.9	$\times 1/[1/(1.4) + 0.04]$	9.15		(27)
Floor			53.6	0.15	8.04	75	4020 (28)
Walls	147.49	14.35	133.14	0.25	33.29	60	7988.4 (29)
Roof	53.6	0	53.6	0.11	5.9	9	482.4 (30)
Total area of elements, m²			254.69				(31)
Internal wall **			161.3			9	1451.7 (32c)
Internal floor			53.6			18	964.8 (32d)
Internal ceiling			53.6			9	482.4 (32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 66.19 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 15389.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 143.56 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

74.19

(37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	54.54	53.9	53.25	50.03	49.39	46.16	46.16	45.52	47.45	49.39	50.68	51.96

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

(39)m=	128.73	128.09	127.44	124.22	123.58	120.35	120.35	119.71	121.64	123.58	124.87	126.16
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Average = Sum(39)_{1...12} / 12 =

124.06

(39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.2	1.19	1.19	1.16	1.15	1.12	1.12	1.12	1.13	1.15	1.16	1.18
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Average = Sum(40)_{1...12} / 12 =

1.16

(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

2.8

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

100.63

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	110.69	106.66	102.64	98.61	94.59	90.56	90.56	94.59	98.61	102.64	106.66	110.69
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Total = Sum(44)_{1...12} =

1207.53

(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	164.15	143.57	148.15	129.16	123.93	106.94	99.1	113.72	115.08	134.11	146.39	158.97
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Total = Sum(45)_{1...12} =

1583.26

(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.12	21.96	23.85
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

0

(54)

Enter (50) or (54) in (55)

0

(55)

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month

$$\{(56)\}m = \{(55)\} \times \{(41)\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	{56}
--------	---	---	---	---	---	---	---	---	---	---	---	------

If cylinder contains dedicated solar storage, $\{(57)\}m = \{(56)\}m \times [(\{(50)\}) - (H11)] \div \{(50)\}$, else $\{(57)\}m = \{(56)\}m$ where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	{57}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Primary circuit loss (annual) from Table 3

0

{58}

Primary circuit loss calculated for each month $\{(59)\}m = \{(58)\} \div 365 \times \{(41)\}m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

{59}m=	0	0	0	0	0	0	0	0	0	0	0	{59}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Combi loss calculated for each month $\{(61)\}m = \{(60)\} \div 365 \times \{(41)\}m$

{61}m=	14.15	12.77	14.11	13.62	14.04	13.55	13.97	14.01	13.59	14.08	13.66	14.14	{61}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month $\{(62)\}m = 0.85 \times \{(45)\}m + \{(46)\}m + \{(57)\}m + \{(59)\}m + \{(61)\}m$

{62}m=	178.3	156.34	162.26	142.78	137.97	120.49	113.07	127.73	128.66	148.19	160.05	173.11	{62}
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

{63}m=	0	0	0	0	0	0	0	0	0	0	0	{63}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

{64}m=	178.3	156.34	162.26	142.78	137.97	120.49	113.07	127.73	128.66	148.19	160.05	173.11	
Output from water heater (annual) $\{(64)\}$												1748.94	{64}

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times \{(45)\}m + \{(61)\}m] + 0.8 \times [(\{(46)\}m + \{(57)\}m + \{(59)\}m)]$

{65}m=	58.12	50.93	52.79	46.35	44.72	38.94	36.44	41.31	41.66	48.11	52.09	56.39	{65}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include $\{(57)\}m$ in calculation of $\{(65)\}m$ only if cylinder is in the dwelling or hot water is from community heating

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=	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	{66}

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

{67}m=	26.75	23.76	19.33	14.63	10.94	9.23	9.98	12.97	17.41	22.1	25.79	27.5	{67}
--------	-------	-------	-------	-------	-------	------	------	-------	-------	------	-------	------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

{68}m=	267.47	270.25	263.25	248.36	229.57	211.9	200.1	197.32	204.32	219.21	238	255.67	{68}
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-----	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

{69}m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	{69}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

{70}m=	3	3	3	3	3	3	3	3	3	3	3	3	{70}
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

{71}m=	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	{71}
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

{72}m=	78.11	75.79	70.95	64.37	60.1	54.09	48.98	55.53	57.86	64.67	72.35	75.8	{72}
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	------

Total internal gains =

$$\{(66)\}m + \{(67)\}m + \{(68)\}m + \{(69)\}m + \{(70)\}m + \{(71)\}m + \{(72)\}m$$

{73}m=	440.29	437.75	421.48	395.32	368.56	343.18	327.01	333.78	347.54	373.93	404.1	426.92	{73}
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

6 Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.9	x	10.63	x	0.45	x	1.11	=	25.42	(74)
North	0.9x	0.77	x	6.9	x	20.32	x	0.45	x	1.11	=	48.58	(74)
North	0.9x	0.77	x	6.9	x	34.53	x	0.45	x	1.11	=	82.56	(74)
North	0.9x	0.77	x	6.9	x	55.46	x	0.45	x	1.11	=	132.61	(74)
North	0.9x	0.77	x	6.9	x	74.72	x	0.45	x	1.11	=	178.63	(74)
North	0.9x	0.77	x	6.9	x	79.99	x	0.45	x	1.11	=	191.23	(74)
North	0.9x	0.77	x	6.9	x	74.68	x	0.45	x	1.11	=	178.54	(74)
North	0.9x	0.77	x	6.9	x	59.25	x	0.45	x	1.11	=	141.65	(74)
North	0.9x	0.77	x	6.9	x	41.52	x	0.45	x	1.11	=	99.26	(74)
North	0.9x	0.77	x	6.9	x	24.19	x	0.45	x	1.11	=	57.83	(74)
North	0.9x	0.77	x	6.9	x	13.12	x	0.45	x	1.11	=	31.36	(74)
North	0.9x	0.77	x	6.9	x	8.86	x	0.45	x	1.11	=	21.19	(74)
South	0.9x	0.77	x	5.35	x	46.75	x	0.45	x	1.11	=	86.67	(78)
South	0.9x	0.77	x	5.35	x	76.57	x	0.45	x	1.11	=	141.94	(78)
South	0.9x	0.77	x	5.35	x	97.53	x	0.45	x	1.11	=	180.81	(78)
South	0.9x	0.77	x	5.35	x	110.23	x	0.45	x	1.11	=	204.35	(78)
South	0.9x	0.77	x	5.35	x	114.87	x	0.45	x	1.11	=	212.95	(78)
South	0.9x	0.77	x	5.35	x	110.55	x	0.45	x	1.11	=	204.93	(78)
South	0.9x	0.77	x	5.35	x	108.01	x	0.45	x	1.11	=	200.23	(78)
South	0.9x	0.77	x	5.35	x	104.89	x	0.45	x	1.11	=	194.45	(78)
South	0.9x	0.77	x	5.35	x	101.89	x	0.45	x	1.11	=	188.87	(78)
South	0.9x	0.77	x	5.35	x	82.59	x	0.45	x	1.11	=	153.1	(78)
South	0.9x	0.77	x	5.35	x	55.42	x	0.45	x	1.11	=	102.73	(78)
South	0.9x	0.77	x	5.35	x	40.4	x	0.45	x	1.11	=	74.89	(78)

Solar gains in watts, calculated for each month

{83}m = Sum(74)m ... (82)m

{83}m=	112.09	190.52	263.36	336.96	391.58	396.16	378.77	336.1	288.13	210.93	134.09	96.08	{83}
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	------

Total gains – internal and solar {84}m = {73}m + {83}m , watts

{84}m=	552.38	628.27	684.84	732.28	760.14	739.34	705.78	669.88	635.67	584.86	538.19	523	{84}
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 {85}

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
{86}m=	0.99	0.98	0.97	0.95	0.9	0.79	0.65	0.69	0.86	0.96	0.99	0.99	{86}

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

{87}m=	18.91	19.12	19.46	19.94	20.38	20.75	20.91	20.88	20.61	20.04	19.41	18.9	{87}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

{88}m=	19.92	19.92	19.93	19.95	19.96	19.98	19.98	19.99	19.97	19.96	19.95	19.94	{88}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

{89}m=	0.99	0.98	0.97	0.94	0.87	0.72	0.53	0.58	0.81	0.95	0.98	0.99	{89}
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

DER WorkSheet: New dwelling design stage

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.13	17.43	17.92	18.63	19.26	19.75	19.92	19.91	19.59	18.79	17.88	17.12	(90)
fLA = Living area ÷ (4) =													(91)
											0.16		

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.41	17.69	18.16	18.83	19.44	19.91	20.08	20.06	19.75	18.99	18.12	17.4	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.26	17.54	18.01	18.68	19.29	19.76	19.93	19.91	19.6	18.84	17.97	17.25	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

6. Space heating calculation

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.92	0.84	0.7	0.53	0.57	0.79	0.93	0.97	0.98	(94)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	541.69	609.79	652.56	670.41	639.22	517.47	372.59	383.23	501.56	541.01	522.29	514.44	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	1668.03	1619.34	1467.5	1215.38	937.35	621.13	400.7	420.51	669.04	1018.13	1357.04	1646.55	(97)
--------	---------	---------	--------	---------	--------	--------	-------	--------	--------	---------	---------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	838	678.42	606.31	392.38	221.81	0	0	0	0	354.97	601.02	842.29	(98)
Total per year (kWh/year) = Sum(98) _{1...12} =													(99)
											4535.21		

Space heating requirement in kWh/m²/year

42.31	(99)
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9a. Energy requirements for individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1	(202)
---	-------

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1	(204)
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Efficiency of main space heating system 1

90.5	(206)
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Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

838	678.42	606.31	392.38	221.81	0	0	0	0	354.97	601.02	842.29
-----	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

925.97	749.64	669.96	433.57	245.1	0	0	0	0	392.23	664.11	930.71
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1...12} =

5011.28	(211)
---------	-------

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1...12} =												0	(215)

Water heating

Output from water heater (calculated above)

178.3	156.34	162.26	142.78	137.97	120.49	113.07	127.73	128.66	148.19	160.05	173.11
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Efficiency of water heater

87.3	(216)
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DER WorkSheet: New dwelling design stage

(217)m=	89.92	89.88	89.81	89.62	89.25	87.3	87.3	87.3	87.3	89.53	89.81	89.94	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	198.28	173.93	180.68	159.31	154.59	138.02	129.52	146.31	147.38	165.51	178.22	192.48	
Total = Sum{(219a)} _{i=1,12} =												1964.23	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

69.35 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 144.35 (231)

Electricity for lighting

472.49 (232)

12a CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	1082.44 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	424.27 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1506.71 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	74.92 (267)
Electricity for lighting	(232) x	0.519	245.22 (268)
Total CO2, kg/year		sum of (265)...(271) =	1826.85 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	17.04 (273)
El rating (section 14)			84 (274)

TER WorkSheet: New dwelling design stage

User Details

Assessor Name: Gerard Mcguigan
Software Name: Stroma FSAP 2012

Stroma Number: STRO011196
Software Version: Version: 1.0.4.18

Property Address: Plot 108

Address : Plot 108, The Hedgerows, Westergate, PO20

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	53.6	(1a) x	2.3	(2a) =	123.28 (3a)
First floor	53.6	(1b) x	2.6	(2b) =	139.36 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.2	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	262.64 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							4	x 10 =	40 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.15 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.4 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
---------	-----	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
--------	-----	------	------	------	------	------	------	------	------	------	------	------

3. Thermal losses and heat capacity parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.1	1	2.1		(26)
Windows Type 1			5.35	$\times 1/[1/(1.4) + 0.04]$	7.09		(27)
Windows Type 2			6.9	$\times 1/[1/(1.4) + 0.04]$	9.15		(27)
Floor			53.6	0.13	6.967999		(28)
Walls	147.49	14.35	133.14	0.18	23.97		(29)
Roof	53.6	0	53.6	0.13	6.97		(30)
Total area of elements, m²			254.69				(31)
Internal wall **			161.3				(32c)
Internal floor			53.6				(32d)
Internal ceiling			53.6				(32e)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 56.24 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 15389.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.45 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

$$(33) + (36) =$$

66.69

(37)

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	51.57	51.25	50.94	49.47	49.19	47.91	47.91	47.67	48.4	49.19	49.75	50.33

(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	118.27	117.95	117.63	116.16	115.88	114.6	114.6	114.36	115.1	115.88	116.44	117.02
--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------	--------

$$\text{Average} = \text{Sum}(39)_{1..12} / 12 =$$

116.16

(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.1	1.1	1.1	1.08	1.08	1.07	1.07	1.07	1.07	1.08	1.09	1.09
--------	-----	-----	-----	------	------	------	------	------	------	------	------	------

$$\text{Average} = \text{Sum}(40)_{1..12} / 12 =$$

1.08

(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

2.8

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

100.63

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	110.69	106.66	102.64	98.61	94.59	90.56	90.56	94.59	98.61	102.64	106.66	110.69
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	--------	--------	--------

$$\text{Total} = \text{Sum}(44)_{1..12} =$$

1207.53

(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	164.15	143.57	148.15	129.16	123.93	106.94	99.1	113.72	115.08	134.11	146.39	158.97
--------	--------	--------	--------	--------	--------	--------	------	--------	--------	--------	--------	--------

$$\text{Total} = \text{Sum}(45)_{1..12} =$$

1583.26

(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.12	21.96	23.85
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

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Water storage loss calculated for each month

$$\{(56)\}m = \{(55)\} \times \{(41)\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	{56}
--------	---	---	---	---	---	---	---	---	---	---	---	------

If cylinder contains dedicated solar storage, $\{(57)\}m = \{(56)\}m \times [(\{(50)\} - (H11)) \div \{(50)\}]$, else $\{(57)\}m = \{(56)\}m$ where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	{57}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Primary circuit loss (annual) from Table 3

0

{58}

Primary circuit loss calculated for each month $\{(59)\}m = \{(58)\} \div 365 \times \{(41)\}m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

{59}m=	0	0	0	0	0	0	0	0	0	0	0	{59}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Combi loss calculated for each month $\{(61)\}m = \{(60)\} \div 365 \times \{(41)\}m$

{61}m=	50.96	46.03	50.96	48.63	48.2	44.66	46.15	48.2	48.63	50.96	49.32	50.96	{61}
--------	-------	-------	-------	-------	------	-------	-------	------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month $\{(62)\}m = 0.85 \times \{(45)\}m + \{(46)\}m + \{(57)\}m + \{(59)\}m + \{(61)\}m$

{62}m=	215.11	189.59	199.11	177.79	172.13	151.6	145.25	161.92	163.71	185.07	195.71	209.93	{62}
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

{63}m=	0	0	0	0	0	0	0	0	0	0	0	{63}
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

{64}m=	215.11	189.59	199.11	177.79	172.13	151.6	145.25	161.92	163.71	185.07	195.71	209.93	
Output from water heater (annual) $\{(64)\}$												2166.91	{64}

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times \{(45)\}m + \{(61)\}m] + 0.8 \times [(\{(46)\}m + \{(57)\}m + \{(59)\}m)]$

{65}m=	67.32	59.24	62	55.1	53.26	46.72	44.49	49.86	50.42	57.33	61	65.6	{65}
--------	-------	-------	----	------	-------	-------	-------	-------	-------	-------	----	------	------

include $\{(57)\}m$ in calculation of $\{(65)\}m$ only if cylinder is in the dwelling or hot water is from community heating

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=	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	139.85	{66}

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

{67}m=	26.75	23.76	19.33	14.63	10.94	9.23	9.98	12.97	17.41	22.1	25.79	27.5	{67}
--------	-------	-------	-------	-------	-------	------	------	-------	-------	------	-------	------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

{68}m=	267.47	270.25	263.25	248.36	229.57	211.9	200.1	197.32	204.32	219.21	238	255.67	{68}
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-----	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

{69}m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	{69}
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

{70}m=	3	3	3	3	3	3	3	3	3	3	3	3	{70}
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

{71}m=	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	-111.88	{71}
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

{72}m=	90.48	88.16	83.33	76.53	71.58	64.89	59.8	67.02	70.03	77.06	84.73	88.17	{72}
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------

Total internal gains =

$$\{(66)\}m + \{(67)\}m + \{(68)\}m + \{(69)\}m + \{(70)\}m + \{(71)\}m + \{(72)\}m$$

{73}m=	452.66	450.12	433.86	407.48	380.04	353.98	337.83	345.26	359.71	386.32	416.48	439.29	{73}
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6 Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.9	x	10.63	x	0.63	x	0.7	=	22.42	(74)
North	0.9x	0.77	x	6.9	x	20.32	x	0.63	x	0.7	=	42.85	(74)
North	0.9x	0.77	x	6.9	x	34.53	x	0.63	x	0.7	=	72.81	(74)
North	0.9x	0.77	x	6.9	x	55.46	x	0.63	x	0.7	=	116.96	(74)
North	0.9x	0.77	x	6.9	x	74.72	x	0.63	x	0.7	=	157.56	(74)
North	0.9x	0.77	x	6.9	x	79.99	x	0.63	x	0.7	=	168.67	(74)
North	0.9x	0.77	x	6.9	x	74.68	x	0.63	x	0.7	=	157.47	(74)
North	0.9x	0.77	x	6.9	x	59.25	x	0.63	x	0.7	=	124.93	(74)
North	0.9x	0.77	x	6.9	x	41.52	x	0.63	x	0.7	=	87.55	(74)
North	0.9x	0.77	x	6.9	x	24.19	x	0.63	x	0.7	=	51.01	(74)
North	0.9x	0.77	x	6.9	x	13.12	x	0.63	x	0.7	=	27.66	(74)
North	0.9x	0.77	x	6.9	x	8.86	x	0.63	x	0.7	=	18.69	(74)
South	0.9x	0.77	x	5.35	x	46.75	x	0.63	x	0.7	=	76.44	(78)
South	0.9x	0.77	x	5.35	x	76.57	x	0.63	x	0.7	=	125.19	(78)
South	0.9x	0.77	x	5.35	x	97.53	x	0.63	x	0.7	=	159.47	(78)
South	0.9x	0.77	x	5.35	x	110.23	x	0.63	x	0.7	=	180.24	(78)
South	0.9x	0.77	x	5.35	x	114.87	x	0.63	x	0.7	=	187.82	(78)
South	0.9x	0.77	x	5.35	x	110.55	x	0.63	x	0.7	=	180.75	(78)
South	0.9x	0.77	x	5.35	x	108.01	x	0.63	x	0.7	=	176.6	(78)
South	0.9x	0.77	x	5.35	x	104.89	x	0.63	x	0.7	=	171.51	(78)
South	0.9x	0.77	x	5.35	x	101.89	x	0.63	x	0.7	=	166.59	(78)
South	0.9x	0.77	x	5.35	x	82.59	x	0.63	x	0.7	=	135.03	(78)
South	0.9x	0.77	x	5.35	x	55.42	x	0.63	x	0.7	=	90.61	(78)
South	0.9x	0.77	x	5.35	x	40.4	x	0.63	x	0.7	=	66.05	(78)

Solar gains in watts, calculated for each month

{83}m = Sum(74)m ... (82)m

{83}m=	98.86	168.04	232.29	297.2	345.37	349.42	334.08	296.44	254.13	186.04	118.27	84.74	{83}
--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	------

Total gains – internal and solar {84}m = {73}m + {83}m , watts

{84}m=	551.53	618.16	666.15	704.67	725.41	703.4	671.9	641.7	613.84	572.36	534.75	524.03	{84}
--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 {85}

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
{86}m=	1	1	1	0.99	0.96	0.86	0.7	0.75	0.93	0.99	1	1	{86}

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

{87}m=	19.74	19.87	20.08	20.37	20.66	20.89	20.97	20.96	20.8	20.43	20.04	19.72	{87}
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

{88}m=	20	20	20	20.01	20.02	20.03	20.03	20.03	20.02	20.02	20.01	20.01	{88}
--------	----	----	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

{89}m=	1	1	0.99	0.98	0.93	0.79	0.57	0.62	0.88	0.98	1	1	{89}
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.49	18.8	19.24	19.64	19.94	20.01	20.01	19.84	19.33	18.75	18.29	(90)
$fLA = \text{Living area} \div (4) =$													(91)
											0.16		

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	18.53	18.71	19	19.41	19.8	20.09	20.16	20.16	19.99	19.5	18.96	18.51	(92)
--------	-------	-------	----	-------	------	-------	-------	-------	-------	------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.53	18.71	19	19.41	19.8	20.09	20.16	20.16	19.99	19.5	18.96	18.51	(93)
--------	-------	-------	----	-------	------	-------	-------	-------	-------	------	-------	-------	------

9. Space heating calculation

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m} = (76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	1	1	0.99	0.98	0.93	0.79	0.59	0.64	0.88	0.98	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	550.4	615.69	660.27	687.73	672.84	556.56	396.72	411.67	540.37	560.74	532.51	523.22	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(93)m - (96)m]$

(97)m=	1683.43	1628.75	1470.85	1221.32	939.15	628.69	408.51	429.79	678.08	1031.85	1380.44	1675.06	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	---------	---------	---------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	842.98	680.78	603.08	384.19	198.14	0	0	0	0	350.5	610.51	856.97	(98)
Total per year ($kWh/year$) = $\text{Sum}(98)_{1..12} =$													(99)
											4527.13		

Space heating requirement in $kWh/m^2/year$

42.23 (99)

9a. Energy requirements for individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.4 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

842.98	680.78	603.08	384.19	198.14	0	0	0	0	350.5	610.51	856.97
--------	--------	--------	--------	--------	---	---	---	---	-------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

902.54	728.89	645.69	411.33	212.14	0	0	0	0	375.27	653.65	917.53
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

Total ($kWh/year$) = $\text{Sum}(211)_{1..12} =$ 4847.04 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1..12} =												0	(215)

Water heating

Output from water heater (calculated above)

215.11	189.59	199.11	177.79	172.13	151.6	145.25	161.92	163.71	185.07	195.71	209.93
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Efficiency of water heater 80.3 (216)

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{217}m=	88.15	87.99	87.66	86.94	85.41	80.3	80.3	80.3	80.3	86.63	87.72	88.22	{217}
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

{219}m=	244.04	215.47	227.13	204.5	201.55	188.8	180.88	201.64	203.87	213.62	223.1	237.97	
Total = Sum({219a}) _{i=1,2} =												2542.56	{219}

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 {230c}

boiler with a fan-assisted flue

45 {230e}

Total electricity for the above, kWh/year

sum of {230a}...{230g} =

75 {231}

Electricity for lighting

472.49 {232}

2a CO2 emissions - Individual heating systems including main CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	{211} x	0.216	1046.96 {261}
Space heating (secondary)	{215} x	0.519	0 {263}
Water heating	{219} x	0.216	549.19 {264}
Space and water heating	{261} + {262} + {263} + {264} =		1596.15 {265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	38.93 {267}
Electricity for lighting	{232} x	0.519	245.22 {268}
Total CO2, kg/year	sum of {265}...{271} =		1880.3 {272}

TER = 17.54 {273}