

DER WorkSheet: New dwelling design stage

User Details:

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Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-01-01

Address : A-01-01, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	56 (1a)	2.5 (2a)	140 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	140 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			3.78	x1/[1/(1.2)+ 0.04]	= 4.33		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			8.45	x1/[1/(1.2)+ 0.04]	= 9.68		(27)
Windows Type 4			4.48	x1/[1/(1.2)+ 0.04]	= 5.13		(27)
Floor			56	x 0.1	= 5.6		(28)
Walls	55.92	20.8	35.12	x 0.18	= 6.32		(29)
Total area of elements, m²			111.92				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 35.85 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.25 (36)

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

Total fabric heat loss (33) + (36) = 39.1 (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=	12.94	12.79	12.64	11.91	11.76	11.02	11.02	10.88	11.32	11.76	12.06	12.35

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

(39)m= 52.04 51.89 51.75 51.01 50.86 50.13 50.13 49.98 50.42 50.86 51.16 51.45
Average = Sum(39)_{1...12} /12= 50.97 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.93	0.93	0.92	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.91	0.92		
Average = Sum(40) _{1...12} /12=													0.91	(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

1.87

(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

78.53

(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=	86.38	83.24	80.1	76.96	73.82	70.68	70.68	73.82	76.96	80.1	83.24	86.38		
Total = Sum(44) _{1...12} =													942.38	(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=	128.11	112.04	115.62	100.8	96.72	83.46	77.34	88.75	89.81	104.66	114.25	124.06		
Total = Sum(45) _{1...12} =													1235.61	(45)

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

(46)m=	19.22	16.81	17.34	15.12	14.51	12.52	11.6	13.31	13.47	15.7	17.14	18.61		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	(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=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	
Output from water heater (annual) _{1...12}												1552.94	(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=	42.6	37.25	38.44	33.52	32.16	27.75	25.72	29.51	29.86	34.8	37.99	41.25	(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=	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	(66)

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

(67)m=	14.51	12.89	10.48	7.93	5.93	5.01	5.41	7.03	9.44	11.99	13.99	14.91	(67)

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

(68)m=	162.76	164.45	160.19	151.13	139.69	128.94	121.76	120.07	124.33	133.39	144.83	155.58	(68)

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

(69)m=	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	(71)

Water heating gains (Table 5)

(72)m=	57.25	55.44	51.67	46.55	43.22	38.54	34.56	39.66	41.47	46.77	52.76	55.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.52	283.77	273.34	256.61	239.85	223.49	212.74	217.77	226.24	243.15	262.58	276.93	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.4	x	0.7	=	34.29	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.4	x	0.7	=	56.16	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.4	x	0.7	=	71.54	(78)

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South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.4	x	0.7	=	80.85	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.4	x	0.7	=	84.25	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.4	x	0.7	=	81.08	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.4	x	0.7	=	79.22	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.4	x	0.7	=	76.94	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.4	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.4	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.4	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.4	x	0.7	=	29.63	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)
Southwest	0.9x	0.77	x	8.45	x	36.79		0.4	x	0.7	=	60.33	(79)
Southwest	0.9x	0.77	x	8.45	x	62.67		0.4	x	0.7	=	102.76	(79)
Southwest	0.9x	0.77	x	8.45	x	85.75		0.4	x	0.7	=	140.6	(79)
Southwest	0.9x	0.77	x	8.45	x	106.25		0.4	x	0.7	=	174.21	(79)
Southwest	0.9x	0.77	x	8.45	x	119.01		0.4	x	0.7	=	195.13	(79)
Southwest	0.9x	0.77	x	8.45	x	118.15		0.4	x	0.7	=	193.72	(79)
Southwest	0.9x	0.77	x	8.45	x	113.91		0.4	x	0.7	=	186.77	(79)
Southwest	0.9x	0.77	x	8.45	x	104.39		0.4	x	0.7	=	171.16	(79)
Southwest	0.9x	0.77	x	8.45	x	92.85		0.4	x	0.7	=	152.24	(79)
Southwest	0.9x	0.77	x	8.45	x	69.27		0.4	x	0.7	=	113.57	(79)
Southwest	0.9x	0.77	x	8.45	x	44.07		0.4	x	0.7	=	72.26	(79)
Southwest	0.9x	0.77	x	8.45	x	31.49		0.4	x	0.7	=	51.63	(79)
West	0.9x	0.77	x	4.48	x	19.64	x	0.4	x	0.7	=	17.07	(80)
West	0.9x	0.77	x	4.48	x	38.42	x	0.4	x	0.7	=	33.4	(80)
West	0.9x	0.77	x	4.48	x	63.27	x	0.4	x	0.7	=	55	(80)
West	0.9x	0.77	x	4.48	x	92.28	x	0.4	x	0.7	=	80.22	(80)
West	0.9x	0.77	x	4.48	x	113.09	x	0.4	x	0.7	=	98.31	(80)
West	0.9x	0.77	x	4.48	x	115.77	x	0.4	x	0.7	=	100.64	(80)
West	0.9x	0.77	x	4.48	x	110.22	x	0.4	x	0.7	=	95.81	(80)
West	0.9x	0.77	x	4.48	x	94.68	x	0.4	x	0.7	=	82.3	(80)
West	0.9x	0.77	x	4.48	x	73.59	x	0.4	x	0.7	=	63.97	(80)
West	0.9x	0.77	x	4.48	x	45.59	x	0.4	x	0.7	=	39.63	(80)

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West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.48</td></tr></table>	4.48	x	<table><tr><td>24.49</td></tr></table>	24.49	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>21.29</td></tr></table>	21.29	(80)
0.77																			
4.48																			
24.49																			
0.4																			
0.7																			
21.29																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.48</td></tr></table>	4.48	x	<table><tr><td>16.15</td></tr></table>	16.15	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>14.04</td></tr></table>	14.04	(80)
0.77																			
4.48																			
16.15																			
0.4																			
0.7																			
14.04																			

Solar gains in watts, calculated for each month

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

(83)m=	131.02	223.97	307.46	380.85	425.18	421.14	406.45	373.75	333.05	247.91	157.1	112	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	416.54	507.74	580.8	637.46	665.03	644.63	619.18	591.52	559.3	491.06	419.67	388.93	(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=	0.94	0.9	0.84	0.74	0.61	0.47	0.35	0.38	0.56	0.78	0.91	0.95	(86)

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

(87)m=	19.35	19.69	20.09	20.49	20.77	20.93	20.98	20.97	20.87	20.49	19.85	19.28	(87)

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

(88)m=	20.54	20.54	20.54	20.54	20.55	20.55	20.55	20.55	20.55	20.55	20.54	20.54	(88)

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

(89)m=	0.94	0.89	0.83	0.72	0.59	0.44	0.31	0.34	0.53	0.76	0.9	0.94	(89)

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

(90)m=	17.93	18.42	18.98	19.54	19.91	20.11	20.16	20.15	20.04	19.56	18.66	17.84	(90)

fLA = Living area ÷ (4) =

0.64

 (91)

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

(92)m=	18.84	19.23	19.68	20.15	20.46	20.63	20.68	20.68	20.57	20.15	19.42	18.76	(92)

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

(93)m=	18.84	19.23	19.68	20.15	20.46	20.63	20.68	20.68	20.57	20.15	19.42	18.76	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.92	0.87	0.81	0.71	0.59	0.44	0.32	0.35	0.53	0.75	0.88	0.93	(94)

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

(95)m=	381.96	442.15	468.71	453.36	391.28	285.86	199.93	207.64	296.87	367.5	368.84	361.02	(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=	756.47	743.46	682.17	573.8	445.62	302.34	204.56	213.7	326.39	485.84	630.22	749.13	(97)

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

(98)m=	278.63	202.47	158.81	86.72	40.42	0	0	0	0	88.05	188.2	288.76

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1332.07

 (98)

Space heating requirement in kWh/m²/year

23.79

 (99)

8c. Space cooling requirement

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	471.18	370.93	379.84	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.91	0.95	0.94	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	430.41	350.68	355.81	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	821.15	790.29	758.71	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m													
set (104)m to zero if (104)m < 3 x (98)m													
(104)m=	0	0	0	0	0	281.33	327.07	299.76	0	0	0	0	
									Total = Sum(104) =		908.17		(104)
Cooled fraction									f C = cooled area ÷ (4) =		0.62		(105)
Intermittency factor (Table 10b)													
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
									Total = Sum(104) =		0		(106)
Space cooling requirement for month = (104)m x (105) x (106)m													
(107)m=	0	0	0	0	0	43.96	51.11	46.84	0	0	0	0	
									Total = Sum(107) =		141.9		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		2.53		(108)

9a. Energy requirements – 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) x [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)														
	278.63	202.47	158.81	86.72	40.42	0	0	0	0	88.05	188.2	288.76		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)	
	278.63	202.47	158.81	86.72	40.42	0	0	0	0	88.05	188.2	288.76		
											Total (kWh/year) = Sum(211) _{1...5,10...12} =		1332.07	(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	0		
												Total (kWh/year) = Sum(215) _{1...5,10...12} =	0	(215)

Water heating

Output from water heater (calculated above)

155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02

Efficiency of water heater

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(216)
	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.38	39.03	40.8	36.31	35.39	31.35	29.85	33.11	33.17	37.67	40.16	43.22	
Total = Sum(219a) _{1..12} =													444.45 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	10.18	11.83	10.84	0	0	0	0	
Total = Sum(221) _{6..8} =													32.85 (221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

106.75	(230a)
106.75	(231)
256.25	(232)
-156.32	(233)
2016.05	(338)

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	0.519	= 691.34 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 230.67 (264)
Space and water heating	(261) + (262) + (263) + (264) =		922.01 (265)
Space cooling	(221) x	0.519	= 17.05 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 55.4 (267)
Electricity for lighting	(232) x	0.519	= 132.99 (268)
Energy saving/generation technologies Item 1		0.519	= -81.13 (269)
Total CO2, kg/year		sum of (265)...(271) =	1046.33 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	18.68 (273)
EI rating (section 14)			86 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-01-02

Address : A-01-02, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50 (1a)	2.5 (2a)	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			1.63	x 1/[1/(1.2)+0.04]	= 1.87		(27)
Floor			50	x 0.1	= 5		(28)
Walls	37.97	12.18	25.79	x 0.18	= 4.64		(29)
Total area of elements, m²			87.97				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 23.7 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.64 (36)

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

Total fabric heat loss (33) + (36) = 26.33 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m=	37.89	37.76	37.62	36.97	36.84	36.18	36.18	36.05	36.44	36.84	37.1	37.36
Average = Sum(39) _{1...12} /12=												36.93 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.76	0.76	0.75	0.74	0.74	0.72	0.72	0.72	0.73	0.74	0.74	0.75		
	Average = Sum(40) _{1...12} /12=												0.74	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
	Total = Sum(44) _{1...12} =												892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
	Total = Sum(45) _{1...12} =												1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.19	11.72	9.53	7.21	5.39	4.55	4.92	6.39	8.58	10.9	12.72	13.56	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.97	261.31	251.7	236.34	221.03	206.03	196.14	200.91	208.66	224.19	242.03	255.13	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)	
East	0.9x	0.77	x	1.63	x	19.64	x	0.4	x	0.7	=	6.21	(76)
East	0.9x	0.77	x	1.63	x	38.42	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	1.63	x	63.27	x	0.4	x	0.7	=	20.01	(76)
East	0.9x	0.77	x	1.63	x	92.28	x	0.4	x	0.7	=	29.19	(76)
East	0.9x	0.77	x	1.63	x	113.09	x	0.4	x	0.7	=	35.77	(76)

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East	0.9x	0.77	x	1.63	x	115.77	x	0.4	x	0.7	=	36.62	(76)
East	0.9x	0.77	x	1.63	x	110.22	x	0.4	x	0.7	=	34.86	(76)
East	0.9x	0.77	x	1.63	x	94.68	x	0.4	x	0.7	=	29.94	(76)
East	0.9x	0.77	x	1.63	x	73.59	x	0.4	x	0.7	=	23.28	(76)
East	0.9x	0.77	x	1.63	x	45.59	x	0.4	x	0.7	=	14.42	(76)
East	0.9x	0.77	x	1.63	x	24.49	x	0.4	x	0.7	=	7.75	(76)
East	0.9x	0.77	x	1.63	x	16.15	x	0.4	x	0.7	=	5.11	(76)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m= 38.95 76.19 125.48 183 224.27 229.58 218.57 187.75 145.93 90.41 48.56 32.03 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 301.92 337.5 377.18 419.34 445.3 435.62 414.71 388.66 354.6 314.6 290.59 287.16 (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=	0.96	0.94	0.89	0.8	0.67	0.5	0.38	0.41	0.63	0.85	0.94	0.96

(86)

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

(87)m= 19.58 19.79 20.14 20.54 20.81 20.95 20.99 20.98 20.89 20.52 19.99 19.54 (87)

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

(88)m=	20.62	20.62	20.62	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.63	20.63	(88)

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

(89)m=	0.95	0.93	0.89	0.79	0.65	0.48	0.35	0.38	0.61	0.84	0.93	0.96	(89)

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

(90)m=	18.36	18.67	19.16	19.73	20.09	20.27	20.31	20.31	20.2	19.71	18.96	18.32	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.91	19.18	19.6	20.1	20.42	20.58	20.62	20.61	20.51	20.08	19.43	18.87	(92)

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

(93)m=	18.91	19.18	19.6	20.1	20.42	20.58	20.62	20.61	20.51	20.08	19.43	18.87	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.92	0.87	0.77	0.64	0.47	0.34	0.38	0.6	0.82	0.91	0.95	(94)

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

(95)m=	283.68	308.9	326.87	324.11	284.34	206.91	143.04	148.58	212.18	257.03	265.63	271.89	(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=	553.71	539.16	493.01	413.91	321.16	216.31	145.32	151.86	233.58	349.04	457.29	548.17	(97)

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

(98)m=	200.9	154.74	123.6	64.65	27.39	0	0	0	0	68.45	138	205.55	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												983.29	(98)

Space heating requirement in kWh/m²/year

19.67	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	340.07	267.72	273.95	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.93	0.96	0.95	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	316.06	256.46	259.73	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	570.94	545.52	515.73	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	183.51	215.07	190.47	0	0	0	0	
Total = Sum(104) =												589.04	(104)

Cooled fraction

f C = cooled area ÷ (4) =	0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	32.11	37.64	33.33	0	0	0	0		
Total = Sum(107) =													103.08	(107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 2.06 (108)

9a. Energy requirements – 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	100	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Cooling System Energy Efficiency Ratio	4.32	(209)

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

Space heating requirement (calculated above)

200.9	154.74	123.6	64.65	27.39	0	0	0	0	68.45	138	205.55

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

200.9	154.74	123.6	64.65	27.39	0	0	0	0	68.45	138	205.55

Total (kWh/year) = Sum(211)_{1..5,10...12} = 983.29 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 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)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32		
Total = Sum(219a) _{1..12} =													425.57	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	7.43	8.71	7.72	0	0	0	0		
Total = Sum(221) _{6..8} =													23.86	(221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	983.29	
Water heating fuel used	425.57	
Space cooling fuel used	23.86	
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	95.31	(230a)
Total electricity for the above, kWh/year sum of (230a)...(230g) =	95.31	(231)

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Electricity for lighting	232.95	(232)
Electricity generated by PVs	-139.91	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1621.07	(338)

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	0.519	=	510.33	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			731.2	(265)
Space cooling	(221) x	0.519	=	12.38	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Energy saving/generation technologies Item 1		0.519	=	-72.61	(269)
Total CO2, kg/year		sum of (265)...(271) =		841.34	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.83	(273)
El rating (section 14)				88	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-01-05

Address : A-01-05, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	92	(1a) x	2.5	(2a) =	230 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	92	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			230 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 4			2.84	x1/[1/(1.2)+ 0.04]	= 3.25		(27)
Floor			92	x 0.1	= 9.2		(28)
Walls	90.55	17.65	72.9	x 0.18	= 13.12		(29)
Total area of elements, m²			182.55				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 42.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.7 (36)

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

Total fabric heat loss (33) + (36) = 46.34 (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=	21.26	21.01	20.77	19.56	19.32	18.11	18.11	17.87	18.6	19.32	19.81	20.29

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

(39)m= 67.6 67.36 67.12 65.91 65.66 64.46 64.46 64.21 64.94 65.66 66.15 66.63
Average = Sum(39)_{1...12} /12= 65.85 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.73	0.73	0.73	0.72	0.71	0.7	0.7	0.7	0.71	0.71	0.72	0.72		
Average = Sum(40) _{1...12} /12=													0.72	(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

2.65

(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

97.19

(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=	106.91	103.02	99.13	95.24	91.36	87.47	87.47	91.36	95.24	99.13	103.02	106.91		
Total = Sum(44) _{1...12} =													1166.25	(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=	158.54	138.66	143.08	124.74	119.7	103.29	95.71	109.83	111.14	129.53	141.39	153.54		
Total = Sum(45) _{1...12} =													1529.14	(45)

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

(46)m=	23.78	20.8	21.46	18.71	17.95	15.49	14.36	16.47	16.67	19.43	21.21	23.03		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.49	163	170.04	150.83	146.65	129.37	122.66	136.78	137.22	156.48	167.47	180.49	(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=	185.49	163	170.04	150.83	146.65	129.37	122.66	136.78	137.22	156.48	167.47	180.49	
Output from water heater (annual) _{1...12}												1846.47	(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=	52.71	46.1	47.58	41.48	39.8	34.34	31.82	36.52	36.95	43.07	47.01	51.05	(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=	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	(66)

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

(67)m=	22.3	19.81	16.11	12.2	9.12	7.7	8.32	10.81	14.51	18.42	21.5	22.92	(67)

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

(68)m=	242.71	245.23	238.88	225.37	208.31	192.28	181.58	179.06	185.4	198.91	215.97	232	(68)

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

(69)m=	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	(71)

Water heating gains (Table 5)

(72)m=	70.85	68.61	63.95	57.61	53.49	47.7	42.77	49.08	51.33	57.89	65.29	68.62	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	398.65	396.43	381.72	357.96	333.71	310.46	295.45	301.73	314.02	338.01	365.55	386.32	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.84	x	10.63	x	0.4	x	0.7	=	5.86	(74)
North	0.9x	0.77	x	2.84	x	20.32	x	0.4	x	0.7	=	11.2	(74)
North	0.9x	0.77	x	2.84	x	34.53	x	0.4	x	0.7	=	19.03	(74)
North	0.9x	0.77	x	2.84	x	55.46	x	0.4	x	0.7	=	30.56	(74)
North	0.9x	0.77	x	2.84	x	74.72	x	0.4	x	0.7	=	41.17	(74)

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North	0.9x	0.77	x	2.84	x	79.99	x	0.4	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.84	x	74.68	x	0.4	x	0.7	=	41.15	(74)
North	0.9x	0.77	x	2.84	x	59.25	x	0.4	x	0.7	=	32.65	(74)
North	0.9x	0.77	x	2.84	x	41.52	x	0.4	x	0.7	=	22.88	(74)
North	0.9x	0.77	x	2.84	x	24.19	x	0.4	x	0.7	=	13.33	(74)
North	0.9x	0.77	x	2.84	x	13.12	x	0.4	x	0.7	=	7.23	(74)
North	0.9x	0.77	x	2.84	x	8.86	x	0.4	x	0.7	=	4.89	(74)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(76)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)

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West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>16.15</td></tr></table>	16.15	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>20.25</td></tr></table>	20.25	(80)
0.77																			
6.46																			
16.15																			
0.4																			
0.7																			
20.25																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>16.15</td></tr></table>	16.15	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>6.68</td></tr></table>	6.68	(80)
0.77																			
2.13																			
16.15																			
0.4																			
0.7																			
6.68																			

Solar gains in watts, calculated for each month

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

(83)m=	54.83	107	176.79	260.66	323.16	332.74	315.97	268.72	206.37	127	68.29	45.16	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	453.48	503.42	558.51	618.61	656.87	643.2	611.42	570.45	520.39	465.01	433.84	431.48	(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=	0.98	0.96	0.94	0.87	0.75	0.59	0.45	0.49	0.72	0.9	0.96	0.98	(86)

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

(87)m=	19.44	19.64	19.97	20.41	20.73	20.92	20.98	20.97	20.83	20.4	19.85	19.41	(87)

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

(88)m=	20.63	20.63	20.64	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.64	20.64	(88)

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

(89)m=	0.97	0.96	0.93	0.86	0.74	0.56	0.42	0.46	0.7	0.89	0.96	0.98	(89)

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

(90)m=	18.18	18.46	18.95	19.57	20.02	20.26	20.32	20.32	20.16	19.57	18.79	18.14	(90)

fLA = Living area ÷ (4) =

0.33

 (91)

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

(92)m=	18.6	18.86	19.29	19.85	20.26	20.48	20.54	20.53	20.38	19.85	19.14	18.57	(92)

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

(93)m=	18.6	18.86	19.29	19.85	20.26	20.48	20.54	20.53	20.38	19.85	19.14	18.57	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.96	0.95	0.91	0.84	0.72	0.55	0.41	0.45	0.68	0.87	0.94	0.97	(94)

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

(95)m=	436.15	476	508.83	518.22	471.38	354.39	247.92	256.58	354	405.93	409.86	417.17	(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=	966.75	940.07	858.58	721.56	561.88	379.23	254.08	265.52	408.06	607.17	796.68	957.21	(97)

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

(98)m=	394.76	311.85	260.22	146.4	67.33	0	0	0	0	149.72	278.51	401.79	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

2010.58

 (98)

Space heating requirement in kWh/m²/year

21.85

 (99)

8c. Space cooling requirement

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	605.88	476.97	488.02	0	0	0	0	(100)	
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.89	0.93	0.92	0	0	0	0	(101)	
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	541.81	445.87	448.88	0	0	0	0	(102)	
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	849.46	810.5	764.05	0	0	0	0	(103)	
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m														
set (104)m to zero if (104)m < 3 x (98)m														
(104)m=	0	0	0	0	0	221.51	271.28	234.49	0	0	0	0		
									Total = Sum(104)	=			727.27	(104)
Cooled fraction									f C = cooled area ÷ (4) =				0.38	(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Total = Sum(104)	=			0	(106)
Space cooling requirement for month = (104)m x (105) x (106)m														
(107)m=	0	0	0	0	0	21.07	25.8	22.3	0	0	0	0		
									Total = Sum(107)	=			69.17	(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =				0.75	(108)

9a. Energy requirements – 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) x [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement (calculated above)													
	394.76	311.85	260.22	146.4	67.33	0	0	0	0	149.72	278.51	401.79	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													
	394.76	311.85	260.22	146.4	67.33	0	0	0	0	149.72	278.51	401.79	
									Total (kWh/year) = Sum(211) _{1...5,10...12} =			2010.58	(211)

Space heating fuel (secondary), kWh/month		
= {[(98)m x (201)] } x 100 ÷ (208)		
(215)m=	0	0
	Total (kWh/year) = Sum(215) _{1...5,10...12} =	
	0	

Water heating

Output from water heater (calculated above)	
	185.49 163 170.04 150.83 146.65 129.37 122.66 136.78 137.22 156.48 167.47 180.49
Efficiency of water heater	348.74
(217)m=	348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74

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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	53.19	46.74	48.76	43.25	42.05	37.1	35.17	39.22	39.35	44.87	48.02	51.75	
Total = Sum(219a) _{1..12} =													529.46 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	4.88	5.97	5.16	0	0	0	0	
Total = Sum(221) _{6..8} =													16.01 (221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

185.9	(230a)
185.9	(231)
393.89	(232)
-256.5	(233)
2879.35	(338)

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	0.519	=	1043.49 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	274.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1318.28 (265)
Space cooling	(221) x	0.519	=	8.31 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	96.48 (267)
Electricity for lighting	(232) x	0.519	=	204.43 (268)
Energy saving/generation technologies Item 1		0.519	=	-133.12 (269)
Total CO2, kg/year		sum of (265)...(271) =		1494.38 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.24 (273)
El rating (section 14)				85 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-02-01

Address : A-02-01, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	56	(1a) x	2.5	(2a) =	140 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			140 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			3.78	x1/[1/(1.2)+ 0.04]	= 4.33		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			8.45	x1/[1/(1.2)+ 0.04]	= 9.68		(27)
Windows Type 4			4.48	x1/[1/(1.2)+ 0.04]	= 5.13		(27)
Walls	55.92	20.8	35.12	x 0.18	= 6.32		(29)
Total area of elements, m²			55.92				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 30.25 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.25 (36)

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

Total fabric heat loss (33) + (36) = 33.5 (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=	12.94	12.79	12.64	11.91	11.76	11.02	11.02	10.88	11.32	11.76	12.06	12.35

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

(39)m=	46.44	46.29	46.15	45.41	45.26	44.53	44.53	44.38	44.82	45.26	45.56	45.85
Average = Sum(39) _{1...12} /12=												45.37 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.83	0.83	0.82	0.81	0.81	0.8	0.8	0.79	0.8	0.81	0.81	0.82		
Average = Sum(40) _{1...12} /12=													0.81	(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

1.87

(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

78.53

(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=	86.38	83.24	80.1	76.96	73.82	70.68	70.68	73.82	76.96	80.1	83.24	86.38		
Total = Sum(44) _{1...12} =													942.38	(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=	128.11	112.04	115.62	100.8	96.72	83.46	77.34	88.75	89.81	104.66	114.25	124.06		
Total = Sum(45) _{1...12} =													1235.61	(45)

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

(46)m=	19.22	16.81	17.34	15.12	14.51	12.52	11.6	13.31	13.47	15.7	17.14	18.61		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	(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=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	
Output from water heater (annual) _{1...12}												1552.94	(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=	42.6	37.25	38.44	33.52	32.16	27.75	25.72	29.51	29.86	34.8	37.99	41.25	(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=	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	(66)

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

(67)m=	14.51	12.89	10.48	7.93	5.93	5.01	5.41	7.03	9.44	11.99	13.99	14.91	(67)

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

(68)m=	162.76	164.45	160.19	151.13	139.69	128.94	121.76	120.07	124.33	133.39	144.83	155.58	(68)

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

(69)m=	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	(71)

Water heating gains (Table 5)

(72)m=	57.25	55.44	51.67	46.55	43.22	38.54	34.56	39.66	41.47	46.77	52.76	55.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.52	283.77	273.34	256.61	239.85	223.49	212.74	217.77	226.24	243.15	262.58	276.93	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.4	x	0.7	=	34.29	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.4	x	0.7	=	56.16	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.4	x	0.7	=	71.54	(78)

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South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.4	x	0.7	=	80.85	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.4	x	0.7	=	84.25	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.4	x	0.7	=	81.08	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.4	x	0.7	=	79.22	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.4	x	0.7	=	76.94	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.4	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.4	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.4	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.4	x	0.7	=	29.63	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)
Southwest	0.9x	0.77	x	8.45	x	36.79		0.4	x	0.7	=	60.33	(79)
Southwest	0.9x	0.77	x	8.45	x	62.67		0.4	x	0.7	=	102.76	(79)
Southwest	0.9x	0.77	x	8.45	x	85.75		0.4	x	0.7	=	140.6	(79)
Southwest	0.9x	0.77	x	8.45	x	106.25		0.4	x	0.7	=	174.21	(79)
Southwest	0.9x	0.77	x	8.45	x	119.01		0.4	x	0.7	=	195.13	(79)
Southwest	0.9x	0.77	x	8.45	x	118.15		0.4	x	0.7	=	193.72	(79)
Southwest	0.9x	0.77	x	8.45	x	113.91		0.4	x	0.7	=	186.77	(79)
Southwest	0.9x	0.77	x	8.45	x	104.39		0.4	x	0.7	=	171.16	(79)
Southwest	0.9x	0.77	x	8.45	x	92.85		0.4	x	0.7	=	152.24	(79)
Southwest	0.9x	0.77	x	8.45	x	69.27		0.4	x	0.7	=	113.57	(79)
Southwest	0.9x	0.77	x	8.45	x	44.07		0.4	x	0.7	=	72.26	(79)
Southwest	0.9x	0.77	x	8.45	x	31.49		0.4	x	0.7	=	51.63	(79)
West	0.9x	0.77	x	4.48	x	19.64	x	0.4	x	0.7	=	17.07	(80)
West	0.9x	0.77	x	4.48	x	38.42	x	0.4	x	0.7	=	33.4	(80)
West	0.9x	0.77	x	4.48	x	63.27	x	0.4	x	0.7	=	55	(80)
West	0.9x	0.77	x	4.48	x	92.28	x	0.4	x	0.7	=	80.22	(80)
West	0.9x	0.77	x	4.48	x	113.09	x	0.4	x	0.7	=	98.31	(80)
West	0.9x	0.77	x	4.48	x	115.77	x	0.4	x	0.7	=	100.64	(80)
West	0.9x	0.77	x	4.48	x	110.22	x	0.4	x	0.7	=	95.81	(80)
West	0.9x	0.77	x	4.48	x	94.68	x	0.4	x	0.7	=	82.3	(80)
West	0.9x	0.77	x	4.48	x	73.59	x	0.4	x	0.7	=	63.97	(80)
West	0.9x	0.77	x	4.48	x	45.59	x	0.4	x	0.7	=	39.63	(80)

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West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.48</td></tr></table>	4.48	x	<table><tr><td>24.49</td></tr></table>	24.49	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>21.29</td></tr></table>	21.29	(80)
0.77																			
4.48																			
24.49																			
0.4																			
0.7																			
21.29																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.48</td></tr></table>	4.48	x	<table><tr><td>16.15</td></tr></table>	16.15	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>14.04</td></tr></table>	14.04	(80)
0.77																			
4.48																			
16.15																			
0.4																			
0.7																			
14.04																			

Solar gains in watts, calculated for each month

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

(83)m=	131.02	223.97	307.46	380.85	425.18	421.14	406.45	373.75	333.05	247.91	157.1	112	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	416.54	507.74	580.8	637.46	665.03	644.63	619.18	591.52	559.3	491.06	419.67	388.93	(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=	0.93	0.89	0.82	0.71	0.57	0.43	0.31	0.34	0.52	0.75	0.89	0.94	(86)

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

(87)m=	19.61	19.94	20.3	20.64	20.86	20.96	20.99	20.99	20.92	20.63	20.07	19.55	(87)

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

(88)m=	20.59	20.59	20.59	20.59	20.6	20.6	20.6	20.6	20.6	20.6	20.59	20.59	(88)

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

(89)m=	0.93	0.88	0.81	0.69	0.55	0.4	0.28	0.31	0.49	0.73	0.89	0.94	(89)

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

(90)m=	18.37	18.83	19.33	19.81	20.09	20.22	20.25	20.25	20.18	19.81	19.03	18.28	(90)

fLA = Living area ÷ (4) =

0.64

 (91)

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

(92)m=	19.16	19.54	19.95	20.34	20.58	20.69	20.72	20.72	20.65	20.33	19.69	19.09	(92)

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

(93)m=	19.16	19.54	19.95	20.34	20.58	20.69	20.72	20.72	20.65	20.33	19.69	19.09	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.91	0.86	0.79	0.68	0.55	0.41	0.29	0.32	0.49	0.72	0.87	0.92	(94)

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

(95)m=	379.94	436.94	458.36	435.4	367.56	262.26	181.24	188.63	276.13	355.37	364.8	359.54	(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=	690.09	677.53	620.53	519.51	401.78	271.28	183.51	191.67	293.72	440.47	573.64	682.59	(97)

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

(98)m=	230.75	161.68	120.65	60.55	25.46	0	0	0	0	63.31	150.37	240.35

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1053.13

 (98)

Space heating requirement in kWh/m ² /year	18.81	(99)

8c. Space cooling requirement

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	418.54	329.49	337.28	0	0	0	0	(100)	
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.95	0.97	0.96	0	0	0	0	(101)	
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	395.53	318.81	324.37	0	0	0	0	(102)	
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	821.15	790.29	758.71	0	0	0	0	(103)	
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m														
set (104)m to zero if (104)m < 3 x (98)m														
(104)m=	0	0	0	0	0	306.45	350.78	323.15	0	0	0	0		
									Total = Sum(104) =		980.38		(104)	
Cooled fraction										f C = cooled area ÷ (4) =		0.62		(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Total = Sum(104) =		0		(106)	
Space cooling requirement for month = (104)m x (105) x (106)m														
(107)m=	0	0	0	0	0	47.88	54.81	50.49	0	0	0	0		
									Total = Sum(107) =		153.18		(107)	
									(107) ÷ (4) =		2.74		(108)	

9a. Energy requirements – 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) x [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)	230.75	161.68	120.65	60.55	25.46	0	0	0	0	63.31	150.37	240.35		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)	
	230.75	161.68	120.65	60.55	25.46	0	0	0	0	63.31	150.37	240.35		
												Total (kWh/year) = Sum(211) _{1...5,10...12} =	1053.13	(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	0		
												Total (kWh/year) = Sum(215) _{1...5,10...12} =	0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)	

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.38	39.03	40.8	36.31	35.39	31.35	29.85	33.11	33.17	37.67	40.16	43.22	
Total = Sum(219a) _{1..12} =													444.45 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	11.08	12.69	11.69	0	0	0	0	
Total = Sum(221) _{6..8} =													35.46 (221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

106.75 (230a)
106.75 (231)
256.25 (232)
-156.32 (233)
1739.72 (338)

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	0.519 =	546.57 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.519 =	230.67 (264)
Space and water heating	(261) + (262) + (263) + (264) =		777.24 (265)
Space cooling	(221) x	0.519 =	18.4 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	55.4 (267)
Electricity for lighting	(232) x	0.519 =	132.99 (268)
Energy saving/generation technologies Item 1		0.519 =	-81.13 (269)
Total CO2, kg/year		sum of (265)...(271) =	902.92 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	16.12 (273)
El rating (section 14)			88 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson **Stroma Number:** STRO006273
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: A-02-02

Address : A-02-02, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50 (1a)	2.5 (2a)	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			1.63	x1/[1/(1.2)+ 0.04]	= 1.87		(27)
Walls	37.97	12.18	25.79	x 0.18	= 4.64		(29)
Total area of elements, m²			37.97				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 18.7 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.64 (36)

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

Total fabric heat loss (33) + (36) = 21.33 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m= 32.89 32.76 32.62 31.97 31.84 31.18 31.18 31.05 31.44 31.84 32.1 32.36
Average = Sum(39)_{1...12} /12= 31.93 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.66	0.66	0.65	0.64	0.64	0.62	0.62	0.62	0.63	0.64	0.64	0.65		
Average = Sum(40) _{1...12} /12=													0.64	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
Total = Sum(44) _{1...12} =													892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
Total = Sum(45) _{1...12} =													1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.19	11.72	9.53	7.21	5.39	4.55	4.92	6.39	8.58	10.9	12.72	13.56	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.97	261.31	251.7	236.34	221.03	206.03	196.14	200.91	208.66	224.19	242.03	255.13	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.63	x	19.64	x	0.4	x	0.7	=	6.21 (76)
East	0.9x	0.77	x	1.63	x	38.42	x	0.4	x	0.7	=	12.15 (76)
East	0.9x	0.77	x	1.63	x	63.27	x	0.4	x	0.7	=	20.01 (76)
East	0.9x	0.77	x	1.63	x	92.28	x	0.4	x	0.7	=	29.19 (76)
East	0.9x	0.77	x	1.63	x	113.09	x	0.4	x	0.7	=	35.77 (76)

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East	0.9x	0.77	x	1.63	x	115.77	x	0.4	x	0.7	=	36.62	(76)
East	0.9x	0.77	x	1.63	x	110.22	x	0.4	x	0.7	=	34.86	(76)
East	0.9x	0.77	x	1.63	x	94.68	x	0.4	x	0.7	=	29.94	(76)
East	0.9x	0.77	x	1.63	x	73.59	x	0.4	x	0.7	=	23.28	(76)
East	0.9x	0.77	x	1.63	x	45.59	x	0.4	x	0.7	=	14.42	(76)
East	0.9x	0.77	x	1.63	x	24.49	x	0.4	x	0.7	=	7.75	(76)
East	0.9x	0.77	x	1.63	x	16.15	x	0.4	x	0.7	=	5.11	(76)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m= 38.95 76.19 125.48 183 224.27 229.58 218.57 187.75 145.93 90.41 48.56 32.03 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 301.92 337.5 377.18 419.34 445.3 435.62 414.71 388.66 354.6 314.6 290.59 287.16 (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=	0.95	0.93	0.87	0.76	0.61	0.45	0.33	0.36	0.57	0.82	0.92	0.96

(86)

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

(87)m= 19.87 20.07 20.38 20.71 20.9 20.98 21 20.99 20.94 20.68 20.23 19.84 (87)

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

(88)m=	20.67	20.67	20.67	20.68	20.68	20.69	20.69	20.69	20.69	20.68	20.68	20.68	(88)

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

(89)m=	0.95	0.92	0.87	0.75	0.6	0.43	0.31	0.34	0.55	0.8	0.92	0.96	(89)

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

(90)m=	18.84	19.13	19.57	20.03	20.28	20.39	20.41	20.41	20.34	20	19.37	18.8	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	19.31	19.56	19.94	20.34	20.56	20.66	20.67	20.67	20.62	20.31	19.76	19.27	(92)

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

(93)m=	19.31	19.56	19.94	20.34	20.56	20.66	20.67	20.67	20.62	20.31	19.76	19.27	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.93	0.91	0.85	0.74	0.59	0.42	0.3	0.34	0.55	0.79	0.9	0.94	(94)

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

(95)m=	282.1	305.69	319.96	309.5	262.69	184.87	126.18	131.42	194.22	248.25	262.67	270.63	(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=	493.64	480.23	438.33	365.67	282.12	188.81	126.98	132.63	204.86	309.02	406.42	487.76	(97)

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

(98)m=	157.39	117.29	88.06	40.45	14.46	0	0	0	0	45.22	103.5	161.55	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												727.92	(98)

Space heating requirement in kWh/m²/year

14.56	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	293.07	230.72	235.95	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.96	0.98	0.98	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	282.59	226.28	230.15	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	570.94	545.52	515.73	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	207.61	237.52	212.47	0	0	0	0	
Total = Sum(104) =												657.6	(104)

Cooled fraction

f C = cooled area ÷ (4) =	0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	36.33	41.57	37.18	0	0	0	0		
Total = Sum(107) =													115.08	(107)
Space cooling requirement in kWh/m ² /year													2.3	(108)
(107) ÷ (4) =														

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)													
157.39	117.29	88.06	40.45	14.46	0	0	0	0	45.22	103.5	161.55		
211)m = [{(98)m x (204)}] x 100 ÷ (206)													(211)
157.39	117.29	88.06	40.45	14.46	0	0	0	0	45.22	103.5	161.55		
Total (kWh/year) =Sum(211) _{1..5,10....12} =												727.92	(211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)

(215)m=	0	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)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39		
Efficiency of water heater												349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32		
Total = Sum(219a) _{1..12} =													425.57	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	8.41	9.62	8.61	0	0	0	0		
Total = Sum(221) _{6..8} =													26.64	(221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		727.92
Water heating fuel used		425.57
Space cooling fuel used		26.64
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31
		(231)

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Electricity for lighting	232.95	(232)
Electricity generated by PVs	-139.91	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1368.48	(338)

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	0.519	=	377.79 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	220.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =			598.66 (265)
Space cooling	(221) x	0.519	=	13.83 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47 (267)
Electricity for lighting	(232) x	0.519	=	120.9 (268)
Energy saving/generation technologies Item 1		0.519	=	-72.61 (269)
Total CO2, kg/year		sum of (265)...(271) =		710.24 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.2 (273)
El rating (section 14)				90 (274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-02-05

Address : A-02-05, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	92	(1a) x	2.5	(2a) =	230 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	92	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			230 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 4			2.84	x1/[1/(1.2)+ 0.04]	= 3.25		(27)
Walls	90.55	17.65	72.9	x 0.18	= 13.12		(29)
Total area of elements, m²			90.55				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 33.44 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.7 (36)

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

Total fabric heat loss (33) + (36) = 37.14 (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=	21.26	21.01	20.77	19.56	19.32	18.11	18.11	17.87	18.6	19.32	19.81	20.29

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

(39)m=	58.4	58.16	57.92	56.71	56.46	55.26	55.26	55.01	55.74	56.46	56.95	57.43
Average = Sum(39) _{1...12} /12=												56.65 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.63	0.63	0.63	0.62	0.61	0.6	0.6	0.6	0.61	0.61	0.62	0.62		
Average = Sum(40) _{1...12} /12=													0.62	(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

2.65

(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

97.19

(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=	106.91	103.02	99.13	95.24	91.36	87.47	87.47	91.36	95.24	99.13	103.02	106.91		
Total = Sum(44) _{1...12} =													1166.25	(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=	158.54	138.66	143.08	124.74	119.7	103.29	95.71	109.83	111.14	129.53	141.39	153.54		
Total = Sum(45) _{1...12} =													1529.14	(45)

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

(46)m=	23.78	20.8	21.46	18.71	17.95	15.49	14.36	16.47	16.67	19.43	21.21	23.03		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.49	163	170.04	150.83	146.65	129.37	122.66	136.78	137.22	156.48	167.47	180.49	(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=	185.49	163	170.04	150.83	146.65	129.37	122.66	136.78	137.22	156.48	167.47	180.49	
Output from water heater (annual) _{1...12}												1846.47	(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=	52.71	46.1	47.58	41.48	39.8	34.34	31.82	36.52	36.95	43.07	47.01	51.05	(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=	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	(66)

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

(67)m=	22.3	19.81	16.11	12.2	9.12	7.7	8.32	10.81	14.51	18.42	21.5	22.92	(67)

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

(68)m=	242.71	245.23	238.88	225.37	208.31	192.28	181.58	179.06	185.4	198.91	215.97	232	(68)

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

(69)m=	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	(71)

Water heating gains (Table 5)

(72)m=	70.85	68.61	63.95	57.61	53.49	47.7	42.77	49.08	51.33	57.89	65.29	68.62	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	398.65	396.43	381.72	357.96	333.71	310.46	295.45	301.73	314.02	338.01	365.55	386.32	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.84	x	10.63	x	0.4	x	0.7	=	5.86	(74)
North	0.9x	0.77	x	2.84	x	20.32	x	0.4	x	0.7	=	11.2	(74)
North	0.9x	0.77	x	2.84	x	34.53	x	0.4	x	0.7	=	19.03	(74)
North	0.9x	0.77	x	2.84	x	55.46	x	0.4	x	0.7	=	30.56	(74)
North	0.9x	0.77	x	2.84	x	74.72	x	0.4	x	0.7	=	41.17	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.84	x	79.99	x	0.4	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.84	x	74.68	x	0.4	x	0.7	=	41.15	(74)
North	0.9x	0.77	x	2.84	x	59.25	x	0.4	x	0.7	=	32.65	(74)
North	0.9x	0.77	x	2.84	x	41.52	x	0.4	x	0.7	=	22.88	(74)
North	0.9x	0.77	x	2.84	x	24.19	x	0.4	x	0.7	=	13.33	(74)
North	0.9x	0.77	x	2.84	x	13.12	x	0.4	x	0.7	=	7.23	(74)
North	0.9x	0.77	x	2.84	x	8.86	x	0.4	x	0.7	=	4.89	(74)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(76)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)

DER WorkSheet: New dwelling design stage

West $0.9 \times \begin{array}{|c|} \hline 0.77 \\ \hline \end{array} \times \begin{array}{|c|} \hline 6.46 \\ \hline \end{array} \times \begin{array}{|c|} \hline 16.15 \\ \hline \end{array} \times \begin{array}{|c|} \hline 0.4 \\ \hline \end{array} \times \begin{array}{|c|} \hline 0.7 \\ \hline \end{array} = \begin{array}{|c|} \hline 20.25 \\ \hline \end{array} \quad (80)$

West $0.9 \times \begin{array}{|c|} \hline 0.77 \\ \hline \end{array} \times \begin{array}{|c|} \hline 2.13 \\ \hline \end{array} \times \begin{array}{|c|} \hline 16.15 \\ \hline \end{array} \times \begin{array}{|c|} \hline 0.4 \\ \hline \end{array} \times \begin{array}{|c|} \hline 0.7 \\ \hline \end{array} = \begin{array}{|c|} \hline 6.68 \\ \hline \end{array} \quad (80)$

Solar gains in watts, calculated for each month

$(83)m = \text{Sum}(74)m \dots (82)m$

$(83)m = \begin{array}{|c|} \hline 54.83 \\ \hline \end{array} \begin{array}{|c|} \hline 107 \\ \hline \end{array} \begin{array}{|c|} \hline 176.79 \\ \hline \end{array} \begin{array}{|c|} \hline 260.66 \\ \hline \end{array} \begin{array}{|c|} \hline 323.16 \\ \hline \end{array} \begin{array}{|c|} \hline 332.74 \\ \hline \end{array} \begin{array}{|c|} \hline 315.97 \\ \hline \end{array} \begin{array}{|c|} \hline 268.72 \\ \hline \end{array} \begin{array}{|c|} \hline 206.37 \\ \hline \end{array} \begin{array}{|c|} \hline 127 \\ \hline \end{array} \begin{array}{|c|} \hline 68.29 \\ \hline \end{array} \begin{array}{|c|} \hline 45.16 \\ \hline \end{array} \quad (83)$

Total gains – internal and solar $(84)m = (73)m + (83)m$, watts

$(84)m = \begin{array}{|c|} \hline 453.48 \\ \hline \end{array} \begin{array}{|c|} \hline 503.42 \\ \hline \end{array} \begin{array}{|c|} \hline 558.51 \\ \hline \end{array} \begin{array}{|c|} \hline 618.61 \\ \hline \end{array} \begin{array}{|c|} \hline 656.87 \\ \hline \end{array} \begin{array}{|c|} \hline 643.2 \\ \hline \end{array} \begin{array}{|c|} \hline 611.42 \\ \hline \end{array} \begin{array}{|c|} \hline 570.45 \\ \hline \end{array} \begin{array}{|c|} \hline 520.39 \\ \hline \end{array} \begin{array}{|c|} \hline 465.01 \\ \hline \end{array} \begin{array}{|c|} \hline 433.84 \\ \hline \end{array} \begin{array}{|c|} \hline 431.48 \\ \hline \end{array} \quad (84)$

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) $\begin{array}{|c|} \hline 21 \\ \hline \end{array} \quad (85)$

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

$(86)m = \begin{array}{|c|} \hline \text{Jan} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Feb} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Mar} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Apr} \\ \hline \end{array} \begin{array}{|c|} \hline \text{May} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Jun} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Jul} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Aug} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Sep} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Oct} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Nov} \\ \hline \end{array} \begin{array}{|c|} \hline \text{Dec} \\ \hline \end{array} \quad (86)$

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

$(87)m = \begin{array}{|c|} \hline 19.74 \\ \hline \end{array} \begin{array}{|c|} \hline 19.93 \\ \hline \end{array} \begin{array}{|c|} \hline 20.23 \\ \hline \end{array} \begin{array}{|c|} \hline 20.6 \\ \hline \end{array} \begin{array}{|c|} \hline 20.85 \\ \hline \end{array} \begin{array}{|c|} \hline 20.97 \\ \hline \end{array} \begin{array}{|c|} \hline 20.99 \\ \hline \end{array} \begin{array}{|c|} \hline 20.99 \\ \hline \end{array} \begin{array}{|c|} \hline 20.91 \\ \hline \end{array} \begin{array}{|c|} \hline 20.58 \\ \hline \end{array} \begin{array}{|c|} \hline 20.1 \\ \hline \end{array} \begin{array}{|c|} \hline 19.71 \\ \hline \end{array} \quad (87)$

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

$(88)m = \begin{array}{|c|} \hline 20.68 \\ \hline \end{array} \begin{array}{|c|} \hline 20.68 \\ \hline \end{array} \begin{array}{|c|} \hline 20.69 \\ \hline \end{array} \begin{array}{|c|} \hline 20.69 \\ \hline \end{array} \begin{array}{|c|} \hline 20.69 \\ \hline \end{array} \begin{array}{|c|} \hline 20.7 \\ \hline \end{array} \begin{array}{|c|} \hline 20.7 \\ \hline \end{array} \begin{array}{|c|} \hline 20.7 \\ \hline \end{array} \begin{array}{|c|} \hline 20.7 \\ \hline \end{array} \begin{array}{|c|} \hline 20.69 \\ \hline \end{array} \begin{array}{|c|} \hline 20.69 \\ \hline \end{array} \begin{array}{|c|} \hline 20.69 \\ \hline \end{array} \quad (88)$

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

$(89)m = \begin{array}{|c|} \hline 0.97 \\ \hline \end{array} \begin{array}{|c|} \hline 0.96 \\ \hline \end{array} \begin{array}{|c|} \hline 0.92 \\ \hline \end{array} \begin{array}{|c|} \hline 0.83 \\ \hline \end{array} \begin{array}{|c|} \hline 0.69 \\ \hline \end{array} \begin{array}{|c|} \hline 0.51 \\ \hline \end{array} \begin{array}{|c|} \hline 0.37 \\ \hline \end{array} \begin{array}{|c|} \hline 0.41 \\ \hline \end{array} \begin{array}{|c|} \hline 0.65 \\ \hline \end{array} \begin{array}{|c|} \hline 0.87 \\ \hline \end{array} \begin{array}{|c|} \hline 0.95 \\ \hline \end{array} \begin{array}{|c|} \hline 0.98 \\ \hline \end{array} \quad (89)$

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

$(90)m = \begin{array}{|c|} \hline 18.67 \\ \hline \end{array} \begin{array}{|c|} \hline 18.94 \\ \hline \end{array} \begin{array}{|c|} \hline 19.38 \\ \hline \end{array} \begin{array}{|c|} \hline 19.91 \\ \hline \end{array} \begin{array}{|c|} \hline 20.24 \\ \hline \end{array} \begin{array}{|c|} \hline 20.39 \\ \hline \end{array} \begin{array}{|c|} \hline 20.42 \\ \hline \end{array} \begin{array}{|c|} \hline 20.42 \\ \hline \end{array} \begin{array}{|c|} \hline 20.33 \\ \hline \end{array} \begin{array}{|c|} \hline 19.88 \\ \hline \end{array} \begin{array}{|c|} \hline 19.21 \\ \hline \end{array} \begin{array}{|c|} \hline 18.63 \\ \hline \end{array} \quad (90)$

$fLA = \text{Living area} \div (4) = \begin{array}{|c|} \hline 0.33 \\ \hline \end{array} \quad (91)$

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

$(92)m = \begin{array}{|c|} \hline 19.02 \\ \hline \end{array} \begin{array}{|c|} \hline 19.27 \\ \hline \end{array} \begin{array}{|c|} \hline 19.66 \\ \hline \end{array} \begin{array}{|c|} \hline 20.14 \\ \hline \end{array} \begin{array}{|c|} \hline 20.44 \\ \hline \end{array} \begin{array}{|c|} \hline 20.59 \\ \hline \end{array} \begin{array}{|c|} \hline 20.61 \\ \hline \end{array} \begin{array}{|c|} \hline 20.61 \\ \hline \end{array} \begin{array}{|c|} \hline 20.52 \\ \hline \end{array} \begin{array}{|c|} \hline 20.12 \\ \hline \end{array} \begin{array}{|c|} \hline 19.51 \\ \hline \end{array} \begin{array}{|c|} \hline 18.99 \\ \hline \end{array} \quad (92)$

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

$(93)m = \begin{array}{|c|} \hline 19.02 \\ \hline \end{array} \begin{array}{|c|} \hline 19.27 \\ \hline \end{array} \begin{array}{|c|} \hline 19.66 \\ \hline \end{array} \begin{array}{|c|} \hline 20.14 \\ \hline \end{array} \begin{array}{|c|} \hline 20.44 \\ \hline \end{array} \begin{array}{|c|} \hline 20.59 \\ \hline \end{array} \begin{array}{|c|} \hline 20.61 \\ \hline \end{array} \begin{array}{|c|} \hline 20.61 \\ \hline \end{array} \begin{array}{|c|} \hline 20.52 \\ \hline \end{array} \begin{array}{|c|} \hline 20.12 \\ \hline \end{array} \begin{array}{|c|} \hline 19.51 \\ \hline \end{array} \begin{array}{|c|} \hline 18.99 \\ \hline \end{array} \quad (93)$

8. 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

Utilisation factor for gains, hm:

$(94)m = \begin{array}{|c|} \hline 0.96 \\ \hline \end{array} \begin{array}{|c|} \hline 0.94 \\ \hline \end{array} \begin{array}{|c|} \hline 0.9 \\ \hline \end{array} \begin{array}{|c|} \hline 0.81 \\ \hline \end{array} \begin{array}{|c|} \hline 0.67 \\ \hline \end{array} \begin{array}{|c|} \hline 0.5 \\ \hline \end{array} \begin{array}{|c|} \hline 0.36 \\ \hline \end{array} \begin{array}{|c|} \hline 0.4 \\ \hline \end{array} \begin{array}{|c|} \hline 0.63 \\ \hline \end{array} \begin{array}{|c|} \hline 0.85 \\ \hline \end{array} \begin{array}{|c|} \hline 0.94 \\ \hline \end{array} \begin{array}{|c|} \hline 0.97 \\ \hline \end{array} \quad (94)$

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

$(95)m = \begin{array}{|c|} \hline 435.21 \\ \hline \end{array} \begin{array}{|c|} \hline 473.65 \\ \hline \end{array} \begin{array}{|c|} \hline 502.72 \\ \hline \end{array} \begin{array}{|c|} \hline 502.3 \\ \hline \end{array} \begin{array}{|c|} \hline 442.56 \\ \hline \end{array} \begin{array}{|c|} \hline 319.71 \\ \hline \end{array} \begin{array}{|c|} \hline 219.47 \\ \hline \end{array} \begin{array}{|c|} \hline 228.18 \\ \hline \end{array} \begin{array}{|c|} \hline 329.16 \\ \hline \end{array} \begin{array}{|c|} \hline 397.12 \\ \hline \end{array} \begin{array}{|c|} \hline 407.65 \\ \hline \end{array} \begin{array}{|c|} \hline 416.51 \\ \hline \end{array} \quad (95)$

Monthly average external temperature from Table 8

$(96)m = \begin{array}{|c|} \hline 4.3 \\ \hline \end{array} \begin{array}{|c|} \hline 4.9 \\ \hline \end{array} \begin{array}{|c|} \hline 6.5 \\ \hline \end{array} \begin{array}{|c|} \hline 8.9 \\ \hline \end{array} \begin{array}{|c|} \hline 11.7 \\ \hline \end{array} \begin{array}{|c|} \hline 14.6 \\ \hline \end{array} \begin{array}{|c|} \hline 16.6 \\ \hline \end{array} \begin{array}{|c|} \hline 16.4 \\ \hline \end{array} \begin{array}{|c|} \hline 14.1 \\ \hline \end{array} \begin{array}{|c|} \hline 10.6 \\ \hline \end{array} \begin{array}{|c|} \hline 7.1 \\ \hline \end{array} \begin{array}{|c|} \hline 4.2 \\ \hline \end{array} \quad (96)$

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

$(97)m = \begin{array}{|c|} \hline 859.84 \\ \hline \end{array} \begin{array}{|c|} \hline 835.6 \\ \hline \end{array} \begin{array}{|c|} \hline 762.39 \\ \hline \end{array} \begin{array}{|c|} \hline 637.42 \\ \hline \end{array} \begin{array}{|c|} \hline 493.71 \\ \hline \end{array} \begin{array}{|c|} \hline 330.71 \\ \hline \end{array} \begin{array}{|c|} \hline 221.73 \\ \hline \end{array} \begin{array}{|c|} \hline 231.64 \\ \hline \end{array} \begin{array}{|c|} \hline 358.02 \\ \hline \end{array} \begin{array}{|c|} \hline 537.32 \\ \hline \end{array} \begin{array}{|c|} \hline 706.57 \\ \hline \end{array} \begin{array}{|c|} \hline 849.54 \\ \hline \end{array} \quad (97)$

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

$(98)m = \begin{array}{|c|} \hline 315.93 \\ \hline \end{array} \begin{array}{|c|} \hline 243.23 \\ \hline \end{array} \begin{array}{|c|} \hline 193.2 \\ \hline \end{array} \begin{array}{|c|} \hline 97.29 \\ \hline \end{array} \begin{array}{|c|} \hline 38.06 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 104.31 \\ \hline \end{array} \begin{array}{|c|} \hline 215.23 \\ \hline \end{array} \begin{array}{|c|} \hline 322.18 \\ \hline \end{array} \quad (98)$

Total per year (kWh/year) = $\text{Sum}(98)_{1..5,9..12} = \begin{array}{|c|} \hline 1529.41 \\ \hline \end{array} \quad (98)$

Space heating requirement in kWh/m²/year $\begin{array}{|c|} \hline 16.62 \\ \hline \end{array} \quad (99)$

8c. Space cooling requirement

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	519.4	408.89	418.1	0	0	0	0	(100)	
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0	(101)	
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	489.9	396.1	401.31	0	0	0	0	(102)	
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	849.46	810.5	764.05	0	0	0	0	(103)	
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m														
set (104)m to zero if (104)m < 3 x (98)m														
(104)m=	0	0	0	0	0	258.88	308.32	269.88	0	0	0	0		
									Total = Sum(104) =		837.07		(104)	
Cooled fraction										f C = cooled area ÷ (4) =		0.38		(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Total = Sum(104) =		0		(106)	
Space cooling requirement for month = (104)m x (105) x (106)m														
(107)m=	0	0	0	0	0	24.62	29.32	25.67	0	0	0	0		
									Total = Sum(107) =		79.61		(107)	
									(107) ÷ (4) =		0.87		(108)	

9a. Energy requirements – 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) x [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)														
	315.93	243.23	193.2	97.29	38.06	0	0	0	0	104.31	215.23	322.18		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														
	315.93	243.23	193.2	97.29	38.06	0	0	0	0	104.31	215.23	322.18		
												Total (kWh/year) = Sum(211) _{1...5,10...12} =	1529.41	(211)

Space heating fuel (secondary), kWh/month	
= {[(98)m x (201)] } x 100 ÷ (208)	
(215)m=	0
Total (kWh/year) = Sum(215) _{1...5,10...12} =	
	0

Water heating

Output from water heater (calculated above)	
	185.49 163 170.04 150.83 146.65 129.37 122.66 136.78 137.22 156.48 167.47 180.49
Efficiency of water heater	348.74
(217)m=	348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74 348.74

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	53.19	46.74	48.76	43.25	42.05	37.1	35.17	39.22	39.35	44.87	48.02	51.75	
Total = Sum(219a) _{1..12} =													529.46 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	5.7	6.79	5.94	0	0	0	0	
Total = Sum(221) _{6..8} =													18.43 (221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

185.9	(230a)
185.9	(231)
393.89	(232)
-256.5	(233)
2400.6	(338)

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	0.519	= 793.77 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 274.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1068.56 (265)
Space cooling	(221) x	0.519	= 9.56 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 96.48 (267)
Electricity for lighting	(232) x	0.519	= 204.43 (268)
Energy saving/generation technologies Item 1		0.519	= -133.12 (269)
Total CO2, kg/year		sum of (265)...(271) =	1245.91 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.54 (273)
El rating (section 14)			88 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-03-01

Address : A-03-01, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	56	(1a) x	2.5	(2a) =	140 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			140 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			3.78	x 1/[1/(1.2)+ 0.04]	= 4.33		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			8.45	x 1/[1/(1.2)+ 0.04]	= 9.68		(27)
Windows Type 4			4.48	x 1/[1/(1.2)+ 0.04]	= 5.13		(27)
Floor			56	x 0.1	= 5.6		(28)
Walls	55.92	20.8	35.12	x 0.18	= 6.32		(29)
Roof	8.29	0	8.29	x 0.14	= 1.16		(30)
Total area of elements, m²			120.21				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 37.01 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.25 (36)

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

Total fabric heat loss (33) + (36) = 40.26 (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=	12.94	12.79	12.64	11.91	11.76	11.02	11.02	10.88	11.32	11.76	12.06	12.35

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

(39)m= 53.2 53.05 52.91 52.17 52.02 51.29 51.29 51.14 51.58 52.02 52.32 52.61 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.95	0.95	0.94	0.93	0.93	0.92	0.92	0.91	0.92	0.93	0.93	0.94		
Average = Sum(40) _{1...12} /12=													0.93	(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

1.87

(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

78.53

(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=	86.38	83.24	80.1	76.96	73.82	70.68	70.68	73.82	76.96	80.1	83.24	86.38		
Total = Sum(44) _{1...12} =													942.38	(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=	128.11	112.04	115.62	100.8	96.72	83.46	77.34	88.75	89.81	104.66	114.25	124.06		
Total = Sum(45) _{1...12} =													1235.61	(45)

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

(46)m=	19.22	16.81	17.34	15.12	14.51	12.52	11.6	13.31	13.47	15.7	17.14	18.61		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	(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=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	
Output from water heater (annual) _{1...12}												1552.94	(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=	42.6	37.25	38.44	33.52	32.16	27.75	25.72	29.51	29.86	34.8	37.99	41.25	(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=	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	(66)

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

(67)m=	14.51	12.89	10.48	7.93	5.93	5.01	5.41	7.03	9.44	11.99	13.99	14.91	(67)

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

(68)m=	162.76	164.45	160.19	151.13	139.69	128.94	121.76	120.07	124.33	133.39	144.83	155.58	(68)

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

(69)m=	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	(71)

Water heating gains (Table 5)

(72)m=	57.25	55.44	51.67	46.55	43.22	38.54	34.56	39.66	41.47	46.77	52.76	55.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.52	283.77	273.34	256.61	239.85	223.49	212.74	217.77	226.24	243.15	262.58	276.93	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.4	x	0.7	=	34.29	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.4	x	0.7	=	56.16	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.4	x	0.7	=	71.54	(78)

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South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.4	x	0.7	=	80.85	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.4	x	0.7	=	84.25	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.4	x	0.7	=	81.08	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.4	x	0.7	=	79.22	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.4	x	0.7	=	76.94	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.4	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.4	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.4	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.4	x	0.7	=	29.63	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)
Southwest	0.9x	0.77	x	8.45	x	36.79		0.4	x	0.7	=	60.33	(79)
Southwest	0.9x	0.77	x	8.45	x	62.67		0.4	x	0.7	=	102.76	(79)
Southwest	0.9x	0.77	x	8.45	x	85.75		0.4	x	0.7	=	140.6	(79)
Southwest	0.9x	0.77	x	8.45	x	106.25		0.4	x	0.7	=	174.21	(79)
Southwest	0.9x	0.77	x	8.45	x	119.01		0.4	x	0.7	=	195.13	(79)
Southwest	0.9x	0.77	x	8.45	x	118.15		0.4	x	0.7	=	193.72	(79)
Southwest	0.9x	0.77	x	8.45	x	113.91		0.4	x	0.7	=	186.77	(79)
Southwest	0.9x	0.77	x	8.45	x	104.39		0.4	x	0.7	=	171.16	(79)
Southwest	0.9x	0.77	x	8.45	x	92.85		0.4	x	0.7	=	152.24	(79)
Southwest	0.9x	0.77	x	8.45	x	69.27		0.4	x	0.7	=	113.57	(79)
Southwest	0.9x	0.77	x	8.45	x	44.07		0.4	x	0.7	=	72.26	(79)
Southwest	0.9x	0.77	x	8.45	x	31.49		0.4	x	0.7	=	51.63	(79)
West	0.9x	0.77	x	4.48	x	19.64	x	0.4	x	0.7	=	17.07	(80)
West	0.9x	0.77	x	4.48	x	38.42	x	0.4	x	0.7	=	33.4	(80)
West	0.9x	0.77	x	4.48	x	63.27	x	0.4	x	0.7	=	55	(80)
West	0.9x	0.77	x	4.48	x	92.28	x	0.4	x	0.7	=	80.22	(80)
West	0.9x	0.77	x	4.48	x	113.09	x	0.4	x	0.7	=	98.31	(80)
West	0.9x	0.77	x	4.48	x	115.77	x	0.4	x	0.7	=	100.64	(80)
West	0.9x	0.77	x	4.48	x	110.22	x	0.4	x	0.7	=	95.81	(80)
West	0.9x	0.77	x	4.48	x	94.68	x	0.4	x	0.7	=	82.3	(80)
West	0.9x	0.77	x	4.48	x	73.59	x	0.4	x	0.7	=	63.97	(80)
West	0.9x	0.77	x	4.48	x	45.59	x	0.4	x	0.7	=	39.63	(80)

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West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.48</td></tr></table>	4.48	x	<table><tr><td>24.49</td></tr></table>	24.49	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>21.29</td></tr></table>	21.29	(80)
0.77																			
4.48																			
24.49																			
0.4																			
0.7																			
21.29																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.48</td></tr></table>	4.48	x	<table><tr><td>16.15</td></tr></table>	16.15	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>14.04</td></tr></table>	14.04	(80)
0.77																			
4.48																			
16.15																			
0.4																			
0.7																			
14.04																			

Solar gains in watts, calculated for each month

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

(83)m=	131.02	223.97	307.46	380.85	425.18	421.14	406.45	373.75	333.05	247.91	157.1	112	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	416.54	507.74	580.8	637.46	665.03	644.63	619.18	591.52	559.3	491.06	419.67	388.93	(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=	0.94	0.9	0.84	0.75	0.62	0.47	0.35	0.38	0.57	0.78	0.91	0.95	(86)

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

(87)m=	19.3	19.64	20.04	20.46	20.76	20.92	20.98	20.97	20.86	20.46	19.81	19.23	(87)

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

(88)m=	20.52	20.53	20.53	20.53	20.54	20.54	20.54	20.54	20.54	20.54	20.53	20.53	(88)

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

(89)m=	0.94	0.89	0.83	0.73	0.6	0.45	0.32	0.35	0.54	0.77	0.9	0.95	(89)

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

(90)m=	17.85	18.33	18.9	19.49	19.87	20.08	20.14	20.13	20.02	19.5	18.59	17.76	(90)

fLA = Living area ÷ (4) =

0.64	(91)

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

(92)m=	18.77	19.16	19.63	20.11	20.44	20.62	20.67	20.67	20.56	20.11	19.36	18.7	(92)

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

(93)m=	18.77	19.16	19.63	20.11	20.44	20.62	20.67	20.67	20.56	20.11	19.36	18.7	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.92	0.87	0.81	0.72	0.59	0.45	0.33	0.36	0.54	0.75	0.88	0.93	(94)

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

(95)m=	382.27	443	470.43	456.45	395.55	290.32	203.59	211.34	300.67	369.55	369.49	361.24	(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=	769.91	756.78	694.61	584.74	454.47	308.64	208.84	218.18	332.99	494.97	641.66	762.61	(97)

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

(98)m=	288.4	210.86	166.78	92.37	43.84	0	0	0	0	93.32	195.96	298.61

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1390.14	(98)

Space heating requirement in kWh/m²/year

24.82	(99)

8c. Space cooling requirement

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	482.09	379.52	388.66	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.91	0.94	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	436.98	356.84	361.83	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	821.15	790.29	758.71	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m													
set (104)m to zero if (104)m < 3 x (98)m													
(104)m=	0	0	0	0	0	276.6	322.49	295.28	0	0	0	0	
									Total = Sum(104) =		894.37		(104)
Cooled fraction									f C = cooled area ÷ (4) =		0.62		(105)
Intermittency factor (Table 10b)													
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
									Total = Sum(104) =		0		(106)
Space cooling requirement for month = (104)m x (105) x (106)m													
(107)m=	0	0	0	0	0	43.22	50.39	46.14	0	0	0	0	
									Total = Sum(107) =		139.75		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		2.5		(108)

9a. Energy requirements – 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) x [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)												kWh/year	
288.4	210.86	166.78	92.37	43.84	0	0	0	0	93.32	195.96	298.61		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)												(211)	
288.4	210.86	166.78	92.37	43.84	0	0	0	0	93.32	195.96	298.61		
											Total (kWh/year) = Sum(211) _{1...5,10...12} =	1390.14	(211)

Space heating fuel (secondary), kWh/month
 = {[(98)m x (201)] } x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)												
155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	
Efficiency of water heater											349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	44.38	39.03	40.8	36.31	35.39	31.35	29.85	33.11	33.17	37.67	40.16	43.22	
Total = Sum(219a) _{1..12} =													444.45 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	10	11.66	10.68	0	0	0	0	
Total = Sum(221) _{6..8} =													32.35 (221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

106.75 (230a)
106.75 (231)
256.25 (232)
-156.32 (233)
2073.62 (338)

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		0.519	=	721.48 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.519	=	230.67 (264)
Space and water heating	(261) + (262) + (263) + (264) =				952.15 (265)
Space cooling	(221) x		0.519	=	16.79 (266)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	55.4 (267)
Electricity for lighting	(232) x		0.519	=	132.99 (268)
Energy saving/generation technologies Item 1			0.519	=	-81.13 (269)
Total CO2, kg/year		sum of (265)...(271) =			1076.21 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			19.22 (273)
EI rating (section 14)					86 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson **Stroma Number:** STRO006273
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: A-03-05

Address : A-03-05, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	92 (1a)	2.5 (2a)	230 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	92 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	230 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 4			2.84	x1/[1/(1.2)+ 0.04]	= 3.25		(27)
Walls	90.55	17.65	72.9	x 0.18	= 13.12		(29)
Roof	44.8	0	44.8	x 0.14	= 6.27		(30)
Total area of elements, m²			135.35				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 39.71 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.7 (36)

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

Total fabric heat loss (33) + (36) = 43.42 (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=	21.26	21.01	20.77	19.56	19.32	18.11	18.11	17.87	18.6	19.32	19.81	20.29

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

(39)m=	64.67	64.43	64.19	62.98	62.74	61.53	61.53	61.29	62.01	62.74	63.22	63.7
Average = Sum(39) _{1...12} /12=												62.92 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.7	0.7	0.7	0.68	0.68	0.67	0.67	0.67	0.67	0.68	0.69	0.69		
	Average = Sum(40) _{1...12} /12=												0.68	(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

2.65

(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

97.19

(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=	106.91	103.02	99.13	95.24	91.36	87.47	87.47	91.36	95.24	99.13	103.02	106.91		
	Total = Sum(44) _{1...12} =												1166.25	(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=	158.54	138.66	143.08	124.74	119.7	103.29	95.71	109.83	111.14	129.53	141.39	153.54		
	Total = Sum(45) _{1...12} =												1529.14	(45)

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

(46)m=	23.78	20.8	21.46	18.71	17.95	15.49	14.36	16.47	16.67	19.43	21.21	23.03		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	185.49	163	170.04	150.83	146.65	129.37	122.66	136.78	137.22	156.48	167.47	180.49	(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=	185.49	163	170.04	150.83	146.65	129.37	122.66	136.78	137.22	156.48	167.47	180.49	
Output from water heater (annual) _{1...12}												1846.47	(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=	52.71	46.1	47.58	41.48	39.8	34.34	31.82	36.52	36.95	43.07	47.01	51.05	(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=	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	132.61	(66)

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

(67)m=	22.3	19.81	16.11	12.2	9.12	7.7	8.32	10.81	14.51	18.42	21.5	22.92	(67)

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

(68)m=	242.71	245.23	238.88	225.37	208.31	192.28	181.58	179.06	185.4	198.91	215.97	232	(68)

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

(69)m=	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	-106.08	(71)

Water heating gains (Table 5)

(72)m=	70.85	68.61	63.95	57.61	53.49	47.7	42.77	49.08	51.33	57.89	65.29	68.62	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	398.65	396.43	381.72	357.96	333.71	310.46	295.45	301.73	314.02	338.01	365.55	386.32	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.84	x	10.63	x	0.4	x	0.7	=	5.86	(74)
North	0.9x	0.77	x	2.84	x	20.32	x	0.4	x	0.7	=	11.2	(74)
North	0.9x	0.77	x	2.84	x	34.53	x	0.4	x	0.7	=	19.03	(74)
North	0.9x	0.77	x	2.84	x	55.46	x	0.4	x	0.7	=	30.56	(74)
North	0.9x	0.77	x	2.84	x	74.72	x	0.4	x	0.7	=	41.17	(74)

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North	0.9x	0.77	x	2.84	x	79.99	x	0.4	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.84	x	74.68	x	0.4	x	0.7	=	41.15	(74)
North	0.9x	0.77	x	2.84	x	59.25	x	0.4	x	0.7	=	32.65	(74)
North	0.9x	0.77	x	2.84	x	41.52	x	0.4	x	0.7	=	22.88	(74)
North	0.9x	0.77	x	2.84	x	24.19	x	0.4	x	0.7	=	13.33	(74)
North	0.9x	0.77	x	2.84	x	13.12	x	0.4	x	0.7	=	7.23	(74)
North	0.9x	0.77	x	2.84	x	8.86	x	0.4	x	0.7	=	4.89	(74)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(76)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)

DER WorkSheet: New dwelling design stage

West $0.9 \times \boxed{0.77} \times \boxed{6.46} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.7} = \boxed{20.25}$ (80)

West $0.9 \times \boxed{0.77} \times \boxed{2.13} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.7} = \boxed{6.68}$ (80)

Solar gains in watts, calculated for each month

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

(83)m=

54.83	107	176.79	260.66	323.16	332.74	315.97	268.72	206.37	127	68.29	45.16

 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=

453.48	503.42	558.51	618.61	656.87	643.2	611.42	570.45	520.39	465.01	433.84	431.48

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.97	0.96	0.93	0.86	0.74	0.57	0.43	0.48	0.71	0.9	0.96	0.98

 (86)

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

(87)m=

19.53	19.73	20.06	20.47	20.77	20.94	20.98	20.98	20.86	20.46	19.93	19.5

 (87)

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

(88)m=

20.65	20.65	20.65	20.66	20.66	20.67	20.67	20.67	20.66	20.66	20.66	20.65

 (88)

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

(89)m=

0.97	0.96	0.93	0.85	0.72	0.55	0.4	0.45	0.68	0.89	0.96	0.98

 (89)

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

(90)m=

18.33	18.61	19.08	19.68	20.09	20.31	20.36	20.35	20.21	19.67	18.92	18.29

 (90)

fLA = Living area ÷ (4) =

0.33

 (91)

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

(92)m=

18.73	18.98	19.41	19.94	20.32	20.52	20.57	20.56	20.43	19.93	19.26	18.7

 (92)

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

(93)m=

18.73	18.98	19.41	19.94	20.32	20.52	20.57	20.56	20.43	19.93	19.26	18.7

 (93)

8. 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

Utilisation factor for gains, hm:

(94)m=

0.96	0.94	0.91	0.83	0.71	0.54	0.39	0.43	0.67	0.87	0.94	0.97

 (94)

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

(95)m=

435.94	475.43	507.27	514.02	463.44	344.28	239.31	248.08	347.08	403.64	409.32	417.04

 (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=

933.34	907.44	828.58	695.38	540.69	364.1	243.96	254.94	392.51	585.43	768.56	923.57

 (97)

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

(98)m=

370.07	290.32	239.06	130.58	57.48	0	0	0	0	135.25	258.65	376.86

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1858.25

 (98)

Space heating requirement in kWh/m²/year

20.2

 (99)

8c. Space cooling requirement

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	578.36	455.3	465.77	0	0	0	0	(100)	
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.91	0.95	0.93	0	0	0	0	(101)	
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	526.76	431.05	434.87	0	0	0	0	(102)	
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	849.46	810.5	764.05	0	0	0	0	(103)	
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m														
set (104)m to zero if (104)m < 3 x (98)m														
(104)m=	0	0	0	0	0	232.34	282.31	244.91	0	0	0	0		
									Total = Sum(104) =		759.57		(104)	
Cooled fraction										f C = cooled area ÷ (4) =		0.38		(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Total = Sum(104) =		0		(106)	
Space cooling requirement for month = (104)m x (105) x (106)m														
(107)m=	0	0	0	0	0	22.1	26.85	23.29	0	0	0	0		
									Total = Sum(107) =		72.24		(107)	
Space cooling requirement in kWh/m²/year										(107) ÷ (4) =		0.79		(108)

9a. Energy requirements – 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) x [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)														
	370.07	290.32	239.06	130.58	57.48	0	0	0	0	135.25	258.65	376.86		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														
	370.07	290.32	239.06	130.58	57.48	0	0	0	0	135.25	258.65	376.86		
											Total (kWh/year) = Sum(211) _{1...5,10...12} =		1858.25	(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	0		
											Total (kWh/year) = Sum(215) _{1...5,10...12} =		0	(215)

Water heating

Output from water heater (calculated above)														
	185.49	163	170.04	150.83	146.65	129.37	122.66	136.78	137.22	156.48	167.47	180.49		
Efficiency of water heater													348.74	(216)
(217)m=	348.74	348.74	348.74	348.74	348.74	348.74	348.74	348.74	348.74	348.74	348.74	348.74	(217)	

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	53.19	46.74	48.76	43.25	42.05	37.1	35.17	39.22	39.35	44.87	48.02	51.75	
Total = Sum(219a) _{1..12} =													529.46 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	5.12	6.22	5.39	0	0	0	0	
Total = Sum(221) _{6..8} =													16.72 (221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

185.9	(230a)
185.9	(231)
393.89	(232)
-256.5	(233)
2727.73	(338)

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	0.519	= 964.43 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 274.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1239.22 (265)
Space cooling	(221) x	0.519	= 8.68 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 96.48 (267)
Electricity for lighting	(232) x	0.519	= 204.43 (268)
Energy saving/generation technologies Item 1		0.519	= -133.12 (269)
Total CO2, kg/year		sum of (265)...(271) =	1415.69 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	15.39 (273)
EI rating (section 14)			86 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson **Stroma Number:** STRO006273
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: A-04-01

Address : A-04-01, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	51 (1a)	2.5 (2a)	127.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	127.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.14 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			4.95	x1/[1/(1.2)+ 0.04]	= 5.67		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.45	x1/[1/(1.2)+ 0.04]	= 2.81		(27)
Windows Type 4			4.95	x1/[1/(1.2)+ 0.04]	= 5.67		(27)
Windows Type 5			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Floor			2.22	x 0.14	= 0.3108		(28)
Walls	56.97	20.7	36.27	x 0.18	= 6.53		(29)
Roof	51	0	51	x 0.14	= 7.14		(30)
Total area of elements, m²			110.19				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 37.79 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.79 (36)

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

Total fabric heat loss (33) + (36) = 41.58 (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

DER WorkSheet: New dwelling design stage

(38)m=

12.39	12.24	12.1	11.37	11.22	10.49	10.49	10.34	10.78	11.22	11.51	11.8

 (38)

Heat transfer coefficient, W/K

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

(39)m=

53.96	53.82	53.67	52.94	52.8	52.07	52.07	51.92	52.36	52.8	53.09	53.38

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

52.91 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.06	1.06	1.05	1.04	1.04	1.02	1.02	1.02	1.03	1.04	1.04	1.05

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

1.04 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

 (41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

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

1.72 (42)

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

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)

75.04 (43)

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=

82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54

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

900.48 (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=

122.41	107.06	110.48	96.32	92.42	79.75	73.9	84.8	85.81	100.01	109.17	118.55

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

1180.67 (45)

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

(46)m=

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15	16.37	17.78

 (46)

Water storage loss:

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

201 (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):

0.54 (48)

Temperature factor from Table 2b

0.8694 (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)

0.87 (55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=

26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95

 (56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95

 (57)

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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (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	0

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	149.36	131.4	137.43	122.4	119.37	105.83	100.85	111.75	111.9	126.96	135.25	145.5

(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	0

(63)

Output from water heater

(64)m=	149.36	131.4	137.43	122.4	119.37	105.83	100.85	111.75	111.9	126.96	135.25	145.5

Output from water heater (annual)_{1...12}

1498

(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	40.7	35.6	36.73	32.03	30.73	26.52	24.57	28.2	28.53	33.25	36.3	39.42

(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=	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98

(66)

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

(67)m=	13.36	11.86	9.65	7.3	5.46	4.61	4.98	6.47	8.69	11.03	12.88	13.73

(67)

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

(68)m=	149.83	151.39	147.47	139.13	128.6	118.7	112.09	110.54	114.45	122.8	133.32	143.22

(68)

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

(69)m=	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6

(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0

(70)

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

(71)m=	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78

(71)

Water heating gains (Table 5)

(72)m=	54.71	52.97	49.37	44.48	41.3	36.83	33.03	37.9	39.63	44.69	50.41	52.98

(72)

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	266.69	265.02	255.28	239.7	224.15	208.93	198.89	203.7	211.57	227.32	245.41	258.72

(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76

(76)

(76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(76)
South	0.9x	0.77	x	4.95	x	46.75	x	0.4	x	0.7	=	44.91	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	4.95	x	76.57	x	0.4	x	0.7	=	73.54	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	4.95	x	97.53	x	0.4	x	0.7	=	93.68	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	4.95	x	110.23	x	0.4	x	0.7	=	105.88	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	4.95	x	114.87	x	0.4	x	0.7	=	110.33	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	4.95	x	110.55	x	0.4	x	0.7	=	106.18	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	4.95	x	108.01	x	0.4	x	0.7	=	103.75	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	4.95	x	104.89	x	0.4	x	0.7	=	100.75	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	4.95	x	101.89	x	0.4	x	0.7	=	97.86	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	4.95	x	82.59	x	0.4	x	0.7	=	79.32	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	4.95	x	55.42	x	0.4	x	0.7	=	53.23	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	4.95	x	40.4	x	0.4	x	0.7	=	38.8	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)
Southwest	0.9x	0.77	x	2.45	x	36.79		0.4	x	0.7	=	17.49	(79)
Southwest	0.9x	0.77	x	2.45	x	62.67		0.4	x	0.7	=	29.79	(79)
Southwest	0.9x	0.77	x	2.45	x	85.75		0.4	x	0.7	=	40.77	(79)
Southwest	0.9x	0.77	x	2.45	x	106.25		0.4	x	0.7	=	50.51	(79)
Southwest	0.9x	0.77	x	2.45	x	119.01		0.4	x	0.7	=	56.58	(79)
Southwest	0.9x	0.77	x	2.45	x	118.15		0.4	x	0.7	=	56.17	(79)
Southwest	0.9x	0.77	x	2.45	x	113.91		0.4	x	0.7	=	54.15	(79)

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Southwest	0.9x	0.77	x	2.45	x	104.39		0.4	x	0.7	=	49.63	(79)
Southwest	0.9x	0.77	x	2.45	x	92.85		0.4	x	0.7	=	44.14	(79)
Southwest	0.9x	0.77	x	2.45	x	69.27		0.4	x	0.7	=	32.93	(79)
Southwest	0.9x	0.77	x	2.45	x	44.07		0.4	x	0.7	=	20.95	(79)
Southwest	0.9x	0.77	x	2.45	x	31.49		0.4	x	0.7	=	14.97	(79)
West	0.9x	0.77	x	4.95	x	19.64	x	0.4	x	0.7	=	18.86	(80)
West	0.9x	0.77	x	4.95	x	38.42	x	0.4	x	0.7	=	36.9	(80)
West	0.9x	0.77	x	4.95	x	63.27	x	0.4	x	0.7	=	60.77	(80)
West	0.9x	0.77	x	4.95	x	92.28	x	0.4	x	0.7	=	88.63	(80)
West	0.9x	0.77	x	4.95	x	113.09	x	0.4	x	0.7	=	108.63	(80)
West	0.9x	0.77	x	4.95	x	115.77	x	0.4	x	0.7	=	111.2	(80)
West	0.9x	0.77	x	4.95	x	110.22	x	0.4	x	0.7	=	105.86	(80)
West	0.9x	0.77	x	4.95	x	94.68	x	0.4	x	0.7	=	90.94	(80)
West	0.9x	0.77	x	4.95	x	73.59	x	0.4	x	0.7	=	70.68	(80)
West	0.9x	0.77	x	4.95	x	45.59	x	0.4	x	0.7	=	43.79	(80)
West	0.9x	0.77	x	4.95	x	24.49	x	0.4	x	0.7	=	23.52	(80)
West	0.9x	0.77	x	4.95	x	16.15	x	0.4	x	0.7	=	15.51	(80)

Solar gains in watts, calculated for each month

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

(83)m=	116.82	203.65	287.83	366.87	416.5	414.93	399.51	362.93	315.62	227.86	140.85	99.33	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	383.51	468.66	543.12	606.57	640.65	623.87	598.4	566.63	527.19	455.18	386.26	358.05	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.94	0.91	0.85	0.76	0.63	0.49	0.37	0.4	0.59	0.8	0.91	0.95	

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

(87)m=	19.05	19.4	19.85	20.34	20.69	20.89	20.96	20.95	20.81	20.33	19.6	18.98	(87)

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

(88)m=	20.47	20.47	20.47	20.48	20.48	20.49	20.49	20.49	20.49	20.48	20.48	20.48	(88)

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

(89)m=	0.94	0.9	0.84	0.74	0.61	0.46	0.33	0.36	0.56	0.78	0.91	0.95	(89)

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

(90)m=	17.44	17.94	18.57	19.25	19.71	19.97	20.04	20.04	19.88	19.26	18.24	17.34	(90)

fLA = Living area ÷ (4) =

0.53 (91)

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

(92)m=	18.29	18.71	19.25	19.82	20.23	20.46	20.53	20.52	20.37	19.82	18.96	18.21	(92)

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

(93)m=	18.29	18.71	19.25	19.82	20.23	20.46	20.53	20.52	20.37	19.82	18.96	18.21	(93)

8. 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=	0.92	0.87	0.81	0.72	0.6	0.45	0.33	0.36	0.55	0.76	0.88	0.93	(94)

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

(95)m=	351.68	409.6	441.07	435.46	382.29	282.68	197.88	205.17	289.01	346.07	340.63	332.15	(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=	754.73	743.2	684.18	578.26	450.12	304.93	204.55	213.93	328.33	486.85	629.39	747.65	(97)

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

(98)m=	299.87	224.18	180.87	102.82	50.47	0	0	0	0	104.74	207.91	309.13	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1479.98 (98)

Space heating requirement in kWh/m²/year

29.02 (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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	489.43	385.29	394.6	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.88	0.92	0.91	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	432	355.03	358.68	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	791.94	761.17	724.69	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	259.15	302.17	272.31	0	0	0	0	(104)

Total = Sum(104) = 833.64 (104)

Cooled fraction

f C = cooled area ÷ (4) = 0.69 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	(106)

Total = Sum(104) = 0 (106)

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

(107)m=	0	0	0	0	0	44.46	51.84	46.72	0	0	0	0	(107)

Total = Sum(107) = 143.03 (107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) = 2.8 (108)

9a. Energy requirements – 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

100 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Cooling System Energy Efficiency Ratio

4.32 (209)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	299.87	224.18	180.87	102.82	50.47	0	0	0	0	104.74	207.91	309.13	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$													(211)
	299.87	224.18	180.87	102.82	50.47	0	0	0	0	104.74	207.91	309.13	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1479.98 (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	0	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	149.36	131.4	137.43	122.4	119.37	105.83	100.85	111.75	111.9	126.96	135.25	145.5	
Efficiency of water heater													349.41 (216)
(217)m =	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m $\times 100 \div (217)m$													
(219)m =	42.75	37.61	39.33	35.03	34.16	30.29	28.86	31.98	32.02	36.34	38.71	41.64	
Total = Sum(219a) _{1..12} =													428.72 (219)
Space cooling fuel, kWh/month.													
(221)m = (107)m $\div (209)$													
(221)m =	0	0	0	0	0	10.29	12	10.81	0	0	0	0	
Total = Sum(221) _{6..8} =													33.11 (221)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													1479.98
Water heating fuel used													428.72
Space cooling fuel used													33.11
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													97.22 (230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												97.22 (231)
Electricity for lighting													235.9 (232)
Electricity generated by PVs													-142.5 (233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													2132.43 (338)

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	0.519 =	768.11 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.519 =	222.51 (264)
Space and water heating	(261) + (262) + (263) + (264) =		990.62 (265)

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Space cooling	(221) x	0.519	=	17.18	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	50.46	(267)
Electricity for lighting	(232) x	0.519	=	122.43	(268)
Energy saving/generation technologies Item 1		0.519	=	-73.96	(269)
Total CO2, kg/year	sum of (265)...(271) =			1106.73	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			21.7	(273)
El rating (section 14)				85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-04-02

Address : A-04-02, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			1.63	x 1/[1/(1.2)+0.04]	= 1.87		(27)
Walls	41.45	12.18	29.27	x 0.18	= 5.27		(29)
Roof	50	0	50	x 0.14	= 7		(30)
Total area of elements, m²			91.45				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 26.32 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.7 (36)

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

Total fabric heat loss (33) + (36) = 30.02 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m=	41.58	41.45	41.31	40.66	40.52	39.87	39.87	39.74	40.13	40.52	40.79	41.05
Average = Sum(39) _{1...12} /12=												40.62 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.83	0.83	0.83	0.81	0.81	0.8	0.8	0.79	0.8	0.81	0.82	0.82		
Average = Sum(40) _{1...12} /12=													0.81	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
Total = Sum(44) _{1...12} =													892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
Total = Sum(45) _{1...12} =													1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.19	11.72	9.53	7.21	5.39	4.55	4.92	6.39	8.58	10.9	12.72	13.56	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.97	261.31	251.7	236.34	221.03	206.03	196.14	200.91	208.66	224.19	242.03	255.13	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)	
East	0.9x	0.77	x	1.63	x	19.64	x	0.4	x	0.7	=	6.21	(76)
East	0.9x	0.77	x	1.63	x	38.42	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	1.63	x	63.27	x	0.4	x	0.7	=	20.01	(76)
East	0.9x	0.77	x	1.63	x	92.28	x	0.4	x	0.7	=	29.19	(76)
East	0.9x	0.77	x	1.63	x	113.09	x	0.4	x	0.7	=	35.77	(76)

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East	0.9x	0.77	x	1.63	x	115.77	x	0.4	x	0.7	=	36.62	(76)
East	0.9x	0.77	x	1.63	x	110.22	x	0.4	x	0.7	=	34.86	(76)
East	0.9x	0.77	x	1.63	x	94.68	x	0.4	x	0.7	=	29.94	(76)
East	0.9x	0.77	x	1.63	x	73.59	x	0.4	x	0.7	=	23.28	(76)
East	0.9x	0.77	x	1.63	x	45.59	x	0.4	x	0.7	=	14.42	(76)
East	0.9x	0.77	x	1.63	x	24.49	x	0.4	x	0.7	=	7.75	(76)
East	0.9x	0.77	x	1.63	x	16.15	x	0.4	x	0.7	=	5.11	(76)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m= 38.95 76.19 125.48 183 224.27 229.58 218.57 187.75 145.93 90.41 48.56 32.03 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 301.92 337.5 377.18 419.34 445.3 435.62 414.71 388.66 354.6 314.6 290.59 287.16 (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=	0.96	0.94	0.9	0.82	0.7	0.54	0.41	0.45	0.67	0.86	0.94	0.97

(86)

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

(87)m= 19.38 19.6 19.96 20.41 20.73 20.92 20.98 20.97 20.83 20.39 19.81 19.34 (87)

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

(88)m=	20.58	20.59	20.59	20.59	20.59	20.6	20.6	20.6	20.6	20.59	20.59	20.59	(88)

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

(89)m=	0.96	0.94	0.9	0.81	0.68	0.51	0.37	0.41	0.64	0.85	0.94	0.96	(89)

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

(90)m=	18.03	18.35	18.87	19.5	19.94	20.18	20.24	20.23	20.08	19.5	18.67	17.98	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.64	18.91	19.36	19.91	20.3	20.51	20.57	20.57	20.42	19.9	19.19	18.59	(92)

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

(93)m=	18.64	18.91	19.36	19.91	20.3	20.51	20.57	20.57	20.42	19.9	19.19	18.59	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.92	0.88	0.79	0.67	0.51	0.37	0.41	0.63	0.83	0.92	0.95	(94)

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

(95)m=	284.35	310.34	330.17	331.55	296.45	220.66	154.33	159.85	222.48	261.34	266.95	272.39	(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=	596.19	580.78	531.49	447.7	348.57	235.81	158.39	165.53	253.73	377.06	493.17	590.9	(97)

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

(98)m=	232.02	181.73	149.78	83.63	38.78	0	0	0	0	86.1	162.88	236.97	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1171.89	(98)

Space heating requirement in kWh/m²/year

23.44	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	374.75	295.02	301.99	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.9	0.94	0.92	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	336.81	276.12	278.63	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	570.94	545.52	515.73	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	168.57	200.44	176.4	0	0	0	0	
Total = Sum(104) =												545.41	(104)

Cooled fraction	f C = cooled area ÷ (4) =	0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	29.5	35.08	30.87	0	0	0	0		
Total = Sum(107) =													95.45	(107)
Space cooling requirement in kWh/m ² /year													1.91	(108)
(107) ÷ (4) =														

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

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

Space heating requirement (calculated above)

	232.02	181.73	149.78	83.63	38.78	0	0	0	0	86.1	162.88	236.97		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	232.02	181.73	149.78	83.63	38.78	0	0	0	0	86.1	162.88	236.97		
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1171.89	(211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)														
(215)m=	0	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)

	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32		
Total = Sum(219a) _{1..12} =													425.57	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	6.83	8.12	7.15	0	0	0	0		
Total = Sum(221) _{6..8} =													22.09	(221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		1171.89
Water heating fuel used		425.57
Space cooling fuel used		22.09
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31 (231)

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Electricity for lighting	232.95	(232)
Electricity generated by PVs	-139.91	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1807.91	(338)

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	0.519	=	608.21	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			829.08	(265)
Space cooling	(221) x	0.519	=	11.47	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Energy saving/generation technologies Item 1		0.519	=	-72.61	(269)
Total CO2, kg/year		sum of (265)...(271) =		938.3	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.77	(273)
El rating (section 14)				87	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: A-04-05

Address : A-04-05, Block A, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			1.63	x 1/[1/(1.2)+ 0.04]	= 1.87		(27)
Windows Type 4			1.63	x 1/[1/(1.2)+ 0.04]	= 1.87		(27)
Floor			50	x 0.14	= 7		(28)
Walls	57.7	13.81	43.89	x 0.18	= 7.9		(29)
Roof	50	0	50	x 0.14	= 7		(30)
Total area of elements, m²			157.7				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 37.82 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 5.26 (36)

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

Total fabric heat loss (33) + (36) = 43.08 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m= 54.63 54.5 54.37 53.71 53.58 52.92 52.92 52.79 53.19 53.58 53.84 54.11 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	1.09	1.09	1.09	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.08	1.08		
Average = Sum(40) _{1...12} /12=													1.07	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
Total = Sum(44) _{1...12} =													892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
Total = Sum(45) _{1...12} =													1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.13	11.66	9.48	7.18	5.37	4.53	4.89	6.36	8.54	10.84	12.66	13.49	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.91	261.25	251.66	236.31	221	206.01	196.11	200.88	208.62	224.14	241.96	255.07	(73)

6. Solar gains:

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

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	1.63	x	10.63	x	0.4	x	0.7	=	3.36	(74)
North	0.9x	0.77	x	1.63	x	20.32	x	0.4	x	0.7	=	6.43	(74)
North	0.9x	0.77	x	1.63	x	34.53	x	0.4	x	0.7	=	10.92	(74)
North	0.9x	0.77	x	1.63	x	55.46	x	0.4	x	0.7	=	17.54	(74)
North	0.9x	0.77	x	1.63	x	74.72	x	0.4	x	0.7	=	23.63	(74)

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North	0.9x	0.77	x	1.63	x	79.99	x	0.4	x	0.7	=	25.3	(74)
North	0.9x	0.77	x	1.63	x	74.68	x	0.4	x	0.7	=	23.62	(74)
North	0.9x	0.77	x	1.63	x	59.25	x	0.4	x	0.7	=	18.74	(74)
North	0.9x	0.77	x	1.63	x	41.52	x	0.4	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	1.63	x	24.19	x	0.4	x	0.7	=	7.65	(74)
North	0.9x	0.77	x	1.63	x	13.12	x	0.4	x	0.7	=	4.15	(74)
North	0.9x	0.77	x	1.63	x	8.86	x	0.4	x	0.7	=	2.8	(74)
East	0.9x	0.77	x	1.63	x	19.64	x	0.4	x	0.7	=	6.21	(76)
East	0.9x	0.77	x	1.63	x	38.42	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	1.63	x	63.27	x	0.4	x	0.7	=	20.01	(76)
East	0.9x	0.77	x	1.63	x	92.28	x	0.4	x	0.7	=	29.19	(76)
East	0.9x	0.77	x	1.63	x	113.09	x	0.4	x	0.7	=	35.77	(76)
East	0.9x	0.77	x	1.63	x	115.77	x	0.4	x	0.7	=	36.62	(76)
East	0.9x	0.77	x	1.63	x	110.22	x	0.4	x	0.7	=	34.86	(76)
East	0.9x	0.77	x	1.63	x	94.68	x	0.4	x	0.7	=	29.94	(76)
East	0.9x	0.77	x	1.63	x	73.59	x	0.4	x	0.7	=	23.28	(76)
East	0.9x	0.77	x	1.63	x	45.59	x	0.4	x	0.7	=	14.42	(76)
East	0.9x	0.77	x	1.63	x	24.49	x	0.4	x	0.7	=	7.75	(76)
East	0.9x	0.77	x	1.63	x	16.15	x	0.4	x	0.7	=	5.11	(76)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>16.15</td></tr></table>	16.15	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>20.25</td></tr></table>	20.25	(80)
0.77																			
6.46																			
16.15																			
0.4																			
0.7																			
20.25																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>16.15</td></tr></table>	16.15	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>6.68</td></tr></table>	6.68	(80)
0.77																			
2.13																			
16.15																			
0.4																			
0.7																			
6.68																			

Solar gains in watts, calculated for each month

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

(83)m=	42.31	82.62	136.4	200.54	247.9	254.88	242.19	206.49	159.07	98.06	52.71	34.83	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	305.22	343.87	388.05	436.85	468.91	460.89	438.3	407.37	367.69	322.2	294.68	289.9	(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=	0.96	0.95	0.92	0.86	0.75	0.61	0.48	0.53	0.73	0.89	0.95	0.97	(86)

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

(87)m=	18.75	18.99	19.42	19.99	20.47	20.79	20.92	20.9	20.64	20.01	19.28	18.7	(87)

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

(88)m=	20.45	20.46	20.46	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.46	20.46	(88)

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

(89)m=	0.96	0.95	0.91	0.84	0.73	0.58	0.43	0.48	0.7	0.88	0.95	0.97	(89)

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

(90)m=	16.99	17.34	17.96	18.77	19.42	19.84	19.98	19.96	19.67	18.81	17.77	16.93	(90)

fLA = Living area ÷ (4) =

0.45	(91)

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

(92)m=	17.79	18.09	18.63	19.32	19.9	20.27	20.41	20.39	20.11	19.36	18.46	17.73	(92)

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

(93)m=	17.79	18.09	18.63	19.32	19.9	20.27	20.41	20.39	20.11	19.36	18.46	17.73	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.92	0.89	0.81	0.71	0.56	0.43	0.47	0.68	0.85	0.92	0.95	(94)

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

(95)m=	287.92	317.64	343.73	355.85	331.72	259.97	187.96	192.49	249.82	274.16	272.24	275.23	(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=	736.81	718.82	659.34	559.77	439.23	300.26	201.56	210.52	319.55	469.16	611.63	732.2	(97)

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

(98)m=	333.97	269.59	234.81	146.82	79.99	0	0	0	0	145.08	244.36	339.99

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1794.63	(98)

Space heating requirement in kWh/m²/year

35.89	(99)

8c. Space cooling requirement

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	497.47	391.62	401.21	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.8	0.85	0.83	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	396.98	334.35	333	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	600.45	573.07	537.55	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m													
set (104)m to zero if (104)m < 3 x (98)m													
(104)m=	0	0	0	0	0	146.5	177.6	152.19	0	0	0	0	
										Total = Sum(104)	=	476.3	(104)
Cooled fraction											f C = cooled area ÷ (4) =	0.7	(105)
Intermittency factor (Table 10b)													
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
										Total = Sum(104)	=	0	(106)
Space cooling requirement for month = (104)m x (105) x (106)m													
(107)m=	0	0	0	0	0	25.64	31.08	26.63	0	0	0	0	
										Total = Sum(107)	=	83.35	(107)
Space cooling requirement in kWh/m²/year											(107) ÷ (4) =	1.67	(108)

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)													
333.97	269.59	234.81	146.82	79.99	0	0	0	0	145.08	244.36	339.99		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
333.97	269.59	234.81	146.82	79.99	0	0	0	0	145.08	244.36	339.99		
Total (kWh/year) =Sum(211) _{1, 5,10,...12} =												1794.63	(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	0	
Total (kWh/year) =Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)													
148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39		
Efficiency of water heater												349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32	
Total = Sum(219a) _{1..12} =													425.57 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	5.93	7.19	6.17	0	0	0	0	
Total = Sum(221) _{6..8} =													19.29 (221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

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	0.519	= 931.41 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 220.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1152.28 (265)
Space cooling	(221) x	0.519	= 10.01 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 49.47 (267)
Electricity for lighting	(232) x	0.519	= 120.31 (268)
Energy saving/generation technologies Item 1		0.519	= -72.61 (269)
Total CO2, kg/year		sum of (265)...(271) =	1259.46 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	25.19 (273)
EI rating (section 14)			82 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-01-01

Address : B-01-01, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	74	(1a) x	2.5	(2a) =	185 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			185 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Floor			74	x 0.1	= 7.4		(28)
Walls	84.32	12.68	71.64	x 0.18	= 12.9		(29)
Total area of elements, m²			158.32				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 34.92 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.25 (36)

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

Total fabric heat loss (33) + (36) = 37.17 (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=	17.1	16.9	16.71	15.74	15.54	14.57	14.57	14.37	14.96	15.54	15.93	16.32

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

(39)m=	54.27	54.07	53.88	52.9	52.71	51.74	51.74	51.54	52.13	52.71	53.1	53.49
Average = Sum(39) _{1...12} /12=												52.86 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.73	0.73	0.73	0.71	0.71	0.7	0.7	0.7	0.7	0.71	0.72	0.72		
Average = Sum(40) _{1...12} /12=													0.71	(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

2.34

(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

89.76

(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=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(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=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	(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=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	
Output from water heater (annual) _{1...12}												1729.54	(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=	48.68	42.58	43.94	38.31	36.76	31.72	29.39	33.73	34.13	39.77	43.42	47.15	(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=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	19.6	17.41	14.16	10.72	8.01	6.76	7.31	9.5	12.75	16.19	18.9	20.14	(67)

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)

Water heating gains (Table 5)

(72)m=	65.43	63.36	59.06	53.2	49.4	44.05	39.5	45.33	47.4	53.46	60.3	63.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	349.57	347.45	334.49	313.71	292.69	272.46	259.35	265.22	275.94	296.93	320.99	338.94	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c	=	Gains (W)		
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

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

(83)m= 52.06 95.69 145.78 199.37 235.98 238.66 228.35 201.16 164.77 110.12 63.72 43.62 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 401.63 443.13 480.27 513.08 528.67 511.12 487.7 466.38 440.71 407.05 384.71 382.56 (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=	0.97	0.95	0.92	0.86	0.75	0.59	0.45	0.49	0.7	0.88	0.95	0.97

(86)

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

(87)m= 19.54 19.73 20.04 20.43 20.74 20.92 20.98 20.97 20.85 20.46 19.94 19.51 (87)

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

(88)m=	20.63	20.63	20.64	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.64	20.64	(88)

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

(89)m=	0.97	0.95	0.92	0.85	0.74	0.57	0.42	0.45	0.67	0.87	0.95	0.97	(89)

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

(90)m=	18.32	18.6	19.05	19.61	20.02	20.26	20.32	20.32	20.18	19.66	18.92	18.28	(90)

fLA = Living area ÷ (4) =	0.35	(91)

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

(92)m=	18.74	18.99	19.39	19.89	20.27	20.49	20.55	20.55	20.41	19.93	19.27	18.7	(92)

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

(93)m=	18.74	18.99	19.39	19.89	20.27	20.49	20.55	20.55	20.41	19.93	19.27	18.7	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.95	0.93	0.9	0.83	0.72	0.56	0.41	0.44	0.66	0.85	0.93	0.96	(94)

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

(95)m=	382.13	413.28	430.97	424.99	379.22	284.27	199.33	206.82	290.11	346.01	357.92	366.28	(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=	783.7	762.04	694.67	581.6	451.66	304.78	204.39	213.66	329.06	492.03	646.25	775.81	(97)

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

(98)m=	298.77	234.36	196.19	112.76	53.9	0	0	0	0	108.64	207.6	304.69	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1516.92	(98)

Space heating requirement in kWh/m²/year

20.5	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	486.33	382.85	391.72	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.89	0.94	0.93	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	435.08	358.25	362.44	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	682.18	653.36	629.68	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	177.91	219.56	198.82	0	0	0	0	
Total = Sum(104) =												596.29	(104)

Cooled fraction

f C = cooled area ÷ (4) =	0.47	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	21.04	25.96	23.51	0	0	0	0		
Total = Sum(107) =													70.51	(107)
Space cooling requirement in kWh/m ² /year													0.95	(108)
(107) ÷ (4) =														

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	298.77	234.36	196.19	112.76	53.9	0	0	0	0	108.64	207.6	304.69		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	298.77	234.36	196.19	112.76	53.9	0	0	0	0	108.64	207.6	304.69		
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1516.92	(211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)														
(215)m=	0	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)														
	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)
Fuel for water heating, kWh/month														
(219)m = (64)m × 100 ÷ (217)m														
(219)m=	49.62	43.62	45.53	40.44	39.35	34.76	33.01	36.74	36.84	41.95	44.83	48.29		
Total = Sum(219a) _{1..12} =													494.99	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	4.87	6.01	5.44	0	0	0	0		
Total = Sum(221) _{6..8} =													16.32	(221)

Annual totals

Space heating fuel used, main system 1	1516.92	
Water heating fuel used	494.99	
Space cooling fuel used	16.32	
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	141.06	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) = 141.06	(231)

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Electricity for lighting	346.14	(232)
Electricity generated by PVs	-662.4	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1853.04	(338)

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	0.519	=	787.28	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	256.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1044.18	(265)
Space cooling	(221) x	0.519	=	8.47	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	73.21	(267)
Electricity for lighting	(232) x	0.519	=	179.65	(268)
Energy saving/generation technologies Item 1		0.519	=	-343.78	(269)
Total CO2, kg/year		sum of (265)...(271) =		961.73	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13	(273)
El rating (section 14)				89	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-01-02

Address : B-01-02, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50 (1a)	2.5 (2a)	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			1.63	x 1/[1/(1.2)+0.04]	= 1.87		(27)
Floor			50	x 0.1	= 5		(28)
Walls	54.62	12.18	42.44	x 0.18	= 7.64		(29)
Total area of elements, m²			104.62				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 26.69 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.41 (36)

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

Total fabric heat loss (33) + (36) = 29.11 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m= 40.66 40.53 40.4 39.74 39.61 38.95 38.95 38.82 39.21 39.61 39.87 40.13
Average = Sum(39)_{1...12} /12= 39.71 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.81	0.81	0.81	0.79	0.79	0.78	0.78	0.78	0.78	0.79	0.8	0.8		
Average = Sum(40) _{1...12} /12=													0.79	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
Total = Sum(44) _{1...12} =													892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
Total = Sum(45) _{1...12} =													1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.19	11.72	9.53	7.21	5.39	4.55	4.92	6.39	8.58	10.9	12.72	13.56	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.97	261.31	251.7	236.34	221.03	206.03	196.14	200.91	208.66	224.19	242.03	255.13	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.63	x	46.75	x	0.4	x	0.7	=	14.79	(78)
South	0.9x	0.77	x	1.63	x	76.57	x	0.4	x	0.7	=	24.22	(78)
South	0.9x	0.77	x	1.63	x	97.53	x	0.4	x	0.7	=	30.85	(78)
South	0.9x	0.77	x	1.63	x	110.23	x	0.4	x	0.7	=	34.87	(78)
South	0.9x	0.77	x	1.63	x	114.87	x	0.4	x	0.7	=	36.33	(78)

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South	0.9x	0.77	x	1.63	x	110.55	x	0.4	x	0.7	=	34.96	(78)
South	0.9x	0.77	x	1.63	x	108.01	x	0.4	x	0.7	=	34.16	(78)
South	0.9x	0.77	x	1.63	x	104.89	x	0.4	x	0.7	=	33.18	(78)
South	0.9x	0.77	x	1.63	x	101.89	x	0.4	x	0.7	=	32.22	(78)
South	0.9x	0.77	x	1.63	x	82.59	x	0.4	x	0.7	=	26.12	(78)
South	0.9x	0.77	x	1.63	x	55.42	x	0.4	x	0.7	=	17.53	(78)
South	0.9x	0.77	x	1.63	x	40.4	x	0.4	x	0.7	=	12.78	(78)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m= 47.52 88.26 136.31 188.68 224.84 227.93 217.87 190.98 154.88 102.11 58.35 39.7 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 310.5 349.56 388.02 425.02 445.86 433.97 414.01 391.89 363.55 326.3 300.37 294.83 (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=	0.96	0.94	0.9	0.81	0.69	0.53	0.4	0.44	0.65	0.85	0.94	0.96

(86)

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

(87)m= 19.45 19.68 20.03 20.45 20.75 20.93 20.98 20.97 20.86 20.45 19.89 19.41 (87)

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

(88)m=	20.59	20.59	20.6	20.6	20.6	20.61	20.61	20.61	20.61	20.6	20.6	20.6	(88)

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

(89)m=	0.95	0.93	0.89	0.8	0.67	0.51	0.37	0.4	0.62	0.84	0.93	0.96	(89)

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

(90)m=	18.15	18.48	18.98	19.57	19.98	20.2	20.26	20.25	20.12	19.59	18.79	18.1	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.74	19.03	19.46	19.97	20.33	20.53	20.58	20.58	20.45	19.98	19.29	18.7	(92)

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

(93)m=	18.74	19.03	19.46	19.97	20.33	20.53	20.58	20.58	20.45	19.98	19.29	18.7	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.91	0.87	0.78	0.66	0.5	0.37	0.4	0.61	0.82	0.91	0.94	(94)

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

(95)m=	291.1	318.94	336.23	332.43	293.84	217.28	151.6	157.3	221.87	266.46	273.85	278.6	(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=	587.25	572.48	523.5	439.94	341.89	231	155.18	162.2	249.12	371.45	485.9	581.75	(97)

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

(98)m=	220.33	170.38	139.33	77.41	35.75	0	0	0	0	78.12	152.67	225.55	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1099.54	(98)

Space heating requirement in kWh/m²/year

21.99	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	366.13	288.23	295.02	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.91	0.94	0.93	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	331.68	271.37	274.53	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	569.01	544.71	519.51	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	170.88	203.36	182.26	0	0	0	0	
Total = Sum(104) =												556.5	(104)

Cooled fraction	f C = cooled area ÷ (4) =	0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	29.9	35.59	31.9	0	0	0	0		
													Total = Sum(107) =	97.39 (107)
Space cooling requirement in kWh/m ² /year													(107) ÷ (4) =	1.95 (108)

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

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

Space heating requirement (calculated above)

	220.33	170.38	139.33	77.41	35.75	0	0	0	0	78.12	152.67	225.55		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	220.33	170.38	139.33	77.41	35.75	0	0	0	0	78.12	152.67	225.55		
													Total (kWh/year) = Sum(211) _{1..5,10...12} =	1099.54 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)														
(215)m=	0	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)

	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32		
													Total = Sum(219a) _{1..12} =	425.57 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	6.92	8.24	7.38	0	0	0	0		
													Total = Sum(221) _{6..8} =	22.54 (221)

Annual totals

		kWh/year	kWh/year
Space heating fuel used, main system 1			1099.54
Water heating fuel used			425.57
Space cooling fuel used			22.54
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		95.31 (231)

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Electricity for lighting	232.95	(232)
Electricity generated by PVs	-447.36	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1428.57	(338)

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	0.519	=	570.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			791.53	(265)
Space cooling	(221) x	0.519	=	11.7	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Energy saving/generation technologies Item 1		0.519	=	-232.18	(269)
Total CO2, kg/year		sum of (265)...(271) =		741.43	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.83	(273)
El rating (section 14)				90	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-01-03

Address : B-01-03, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Floor			50	x 0.1	= 5		(28)
Walls	37.97	10.55	27.42	x 0.18	= 4.94		(29)
Total area of elements, m²			87.97				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 22.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 1.72 (36)

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

Total fabric heat loss (33) + (36) = 23.84 (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=	10.96	10.84	10.72	10.12	10	9.4	9.4	9.28	9.64	10	10.24	10.48

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

(39)m= 34.8 34.69 34.57 33.97 33.85 33.25 33.25 33.13 33.49 33.85 34.09 34.33
Average = Sum(39)_{1...12} /12= 33.94 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.7	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.67	0.68	0.68	0.69		
Average = Sum(40) _{1...12} /12=													0.68	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
Total = Sum(44) _{1...12} =													892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
Total = Sum(45) _{1...12} =													1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)

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West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m=	32.74	64.04	105.46	153.81	188.5	192.97	183.71	157.81	122.66	75.99	40.82	26.92	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	296.03	325.63	357.4	390.33	409.66	399.11	379.97	358.87	331.53	300.45	283.15	282.38	(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=	0.96	0.94	0.9	0.81	0.68	0.51	0.38	0.41	0.63	0.85	0.93	0.96	(86)

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

(87)m=	19.74	19.93	20.23	20.59	20.84	20.96	20.99	20.99	20.91	20.58	20.11	19.7	(87)

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

(88)m=	20.65	20.65	20.65	20.66	20.66	20.67	20.67	20.67	20.67	20.66	20.66	20.66	(88)

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

(89)m=	0.95	0.93	0.89	0.8	0.66	0.49	0.35	0.39	0.61	0.84	0.93	0.96	(89)

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

(90)m=	18.63	18.9	19.34	19.85	20.17	20.33	20.36	20.36	20.27	19.84	19.17	18.58	(90)

fLA = Living area ÷ (4) =

0.45 (91)

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

(92)m=	19.13	19.36	19.74	20.19	20.47	20.62	20.65	20.65	20.56	20.18	19.6	19.09	(92)

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

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(93)m=	19.13	19.36	19.74	20.19	20.47	20.62	20.65	20.65	20.56	20.18	19.6	19.09	(93)

8. Space heating requirement

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=	0.94	0.92	0.87	0.78	0.65	0.48	0.35	0.38	0.6	0.82	0.91	0.95	(94)

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

(95)m=	278.19	298.65	311.43	304.93	265.57	192.44	132.86	138.15	198.97	245.7	258.8	267.37	(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 , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	516.15	501.71	457.72	383.31	296.98	200.02	134.58	140.62	216.28	324.22	425.98	511.12	(97)

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

(98)m=	177.04	136.46	108.84	56.44	23.37	0	0	0	0	58.42	120.37	181.35	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												862.29	(98)

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

17.25	(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

Heat loss rate L_m (calculated using $25^\circ C$ internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	312.52	246.02	251.76	0	0	0	0	(100)

Utilisation factor for loss h_m

(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0	(101)

Useful loss, $h_m L_m$ (Watts) = $(100)m \times (101)m$

(102)m=	0	0	0	0	0	293.49	237.46	241	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	528.42	505.08	481.12	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$
set $(104)m$ to zero if $(104)m < 3 \times (98)m$

(104)m=	0	0	0	0	0	169.15	199.11	178.65	0	0	0	0	
Total = $Sum(104) =$												546.91	(104)
Cooled fraction $f_C = \text{cooled area} \div (4) =$												0.7	(105)

Intermittency factor (Table 10b)

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

Space cooling requirement for month = $(104)m \times (105) \times (106)m$

(107)m=	0	0	0	0	0	29.6	34.84	31.26	0	0	0	0	
Total = $Sum(107) =$												95.71	(107)

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

$(107) \div (4) =$	1.91	(108)

9a. Energy requirements – 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)

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Efficiency of main space heating system 1	100	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Cooling System Energy Efficiency Ratio	4.32	(209)

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

Space heating requirement (calculated above)

177.04	136.46	108.84	56.44	23.37	0	0	0	0	58.42	120.37	181.35

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

177.04	136.46	108.84	56.44	23.37	0	0	0	0	58.42	120.37	181.35

Total (kWh/year) =Sum(211)_{1...5,10...12} = 862.29 (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	0

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

Water heating

Output from water heater (calculated above)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Efficiency of water heater	349.41	(216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32

Total = Sum(219a)_{1...12} = 425.57 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=

0	0	0	0	0	6.85	8.07	7.24	0	0	0	0

Total = Sum(221)_{6...8} = 22.15 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	862.29	
Water heating fuel used	425.57	
Space cooling fuel used	22.15	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside	95.31	(230a)

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31	(231)

Electricity for lighting	238.63	(232)

Electricity generated by PVs	-447.36	(233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1196.6	(338)

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		0.519	=	447.53 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)

DER WorkSheet: New dwelling design stage

Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			668.4	(265)
Space cooling	(221) x	0.519	=	11.5	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Energy saving/generation technologies Item 1		0.519	=	-232.18	(269)
Total CO2, kg/year		sum of (265)...(271) =		621.04	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.42	(273)
El rating (section 14)				91	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-01-04

Address : B-01-04, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	86	(1a) x	2.5	(2a) =	215 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			215 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 4			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Floor			86	x 0.1	= 8.6		(28)
Walls	70.93	23.33	47.6	x 0.18	= 8.57		(29)
Total area of elements, m²			156.93				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 43.99 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.53 (36)

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

Total fabric heat loss (33) + (36) = 47.52 (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=	19.87	19.64	19.42	18.29	18.06	16.93	16.93	16.7	17.38	18.06	18.51	18.97

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

(39)m= 67.39 67.16 66.93 65.8 65.58 64.45 64.45 64.22 64.9 65.58 66.03 66.48
Average = Sum(39)_{1...12} /12= 65.75 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.78	0.78	0.78	0.77	0.76	0.75	0.75	0.75	0.75	0.76	0.77	0.77		
	Average = Sum(40) _{1...12} /12=												0.76	(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

2.57

(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

95.16

(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=	104.68	100.87	97.07	93.26	89.45	85.65	85.65	89.45	93.26	97.07	100.87	104.68		
	Total = Sum(44) _{1...12} =												1141.97	(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=	155.24	135.77	140.11	122.15	117.2	101.14	93.72	107.54	108.83	126.83	138.44	150.34		
	Total = Sum(45) _{1...12} =												1497.31	(45)

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

(46)m=	23.29	20.37	21.02	18.32	17.58	15.17	14.06	16.13	16.32	19.02	20.77	22.55		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.19	160.12	167.06	148.23	144.15	127.22	120.67	134.49	134.91	153.78	164.53	177.29	(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=	182.19	160.12	167.06	148.23	144.15	127.22	120.67	134.49	134.91	153.78	164.53	177.29	
Output from water heater (annual) _{1...12}												1814.64	(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=	51.62	45.14	46.58	40.61	38.97	33.63	31.16	35.76	36.19	42.17	46.03	49.99	(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=	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	(66)

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

(67)m=	20.64	18.33	14.91	11.29	8.44	7.12	7.7	10	13.43	17.05	19.9	21.21	(67)

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

(68)m=	231.52	233.93	227.87	214.98	198.71	183.42	173.21	170.8	176.86	189.75	206.02	221.31	(68)

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

(69)m=	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	(71)

Water heating gains (Table 5)

(72)m=	69.38	67.18	62.61	56.41	52.38	46.71	41.88	48.06	50.26	56.68	63.93	67.19	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	383.05	380.94	366.9	344.18	321.03	298.75	284.29	290.37	302.05	324.98	351.35	371.21	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.13	x	10.63	x	0.4	x	0.7	=	21.97	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	41.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	71.36	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	114.62	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	154.4	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	165.29	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	154.32	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	122.43	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	85.8	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	49.99	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	27.11	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	18.32	(74)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)

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West $0.9 \times \boxed{0.77} \times \boxed{6.46} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.7} = \boxed{20.25}$ (80)

West $0.9 \times \boxed{0.77} \times \boxed{2.13} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.7} = \boxed{6.68}$ (80)

Solar gains in watts, calculated for each month

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

(83)m=

74.03	137.68	217.13	313.99	390.38	403.95	382.68	323.59	250.56	160.11	90.83	61.94

 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=

457.08	518.62	584.03	658.17	711.42	702.7	666.97	613.97	552.61	485.09	442.19	433.15

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.97	0.95	0.92	0.84	0.71	0.54	0.41	0.46	0.69	0.88	0.96	0.98

 (86)

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

(87)m=

19.38	19.6	19.97	20.42	20.75	20.93	20.98	20.97	20.84	20.39	19.81	19.34

 (87)

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

(88)m=

20.61	20.61	20.61	20.62	20.62	20.63	20.63	20.63	20.62	20.62	20.62	20.61

 (88)

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

(89)m=

0.97	0.95	0.91	0.83	0.69	0.52	0.38	0.43	0.66	0.87	0.95	0.97

 (89)

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

(90)m=

18.06	18.38	18.91	19.55	20	20.23	20.28	20.28	20.12	19.53	18.7	18.01

 (90)

fLA = Living area ÷ (4) =

0.17

 (91)

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

(92)m=

18.28	18.59	19.09	19.7	20.13	20.35	20.4	20.39	20.24	19.68	18.89	18.24

 (92)

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

(93)m=

18.28	18.59	19.09	19.7	20.13	20.35	20.4	20.39	20.24	19.68	18.89	18.24

 (93)

8. 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

Utilisation factor for gains, hm:

(94)m=

0.95	0.93	0.89	0.8	0.67	0.5	0.36	0.41	0.64	0.85	0.93	0.96

 (94)

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

(95)m=

435.5	482.9	519.03	528.14	475.54	350.28	240.08	249.18	351.82	410.39	411.96	415.4

 (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=

942.2	919.55	842.52	710.56	552.6	370.4	244.93	256.49	398.76	595.17	778.43	933.09

 (97)

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

(98)m=

376.98	293.43	240.68	131.34	57.33	0	0	0	0	137.47	263.86	385.16

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1886.25

 (98)

Space heating requirement in kWh/m²/year

21.93

 (99)

8c. Space cooling requirement

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	605.8	476.91	488.08	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	0.94	0.92	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	547.65	448.32	451.02	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	914.73	871.23	810.54	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m													
set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	264.3	314.65	267.48	0	0	0	0	
									Total = Sum(104) =		846.43		(104)
Cooled fraction									f C = cooled area ÷ (4) =		0.41		(105)
Intermittency factor (Table 10b)													
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
									Total = Sum(104) =		0		(106)
Space cooling requirement for month = (104)m × (105) × (106)m													
(107)m=	0	0	0	0	0	26.89	32.01	27.21	0	0	0	0	
									Total = Sum(107) =		86.12		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		1		(108)

9a. Energy requirements – 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

100

(206)

Efficiency of secondary/supplementary heating system, %

0

(208)

Cooling System Energy Efficiency Ratio

4.32

(209)

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

kWh/year

Space heating requirement (calculated above)

376.98	293.43	240.68	131.34	57.33	0	0	0	0	137.47	263.86	385.16

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

(211)

376.98	293.43	240.68	131.34	57.33	0	0	0	0	137.47	263.86	385.16

Total (kWh/year) =Sum(211)_{1...5,10...12} =

1886.25

(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	0

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

0

(215)

Water heating

Output from water heater (calculated above)

182.19	160.12	167.06	148.23	144.15	127.22	120.67	134.49	134.91	153.78	164.53	177.29

Efficiency of water heater

349.41

(216)

(217)m=

349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41

(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	52.14	45.82	47.81	42.42	41.26	36.41	34.54	38.49	38.61	44.01	47.09	50.74		
Total = Sum(219a) _{1..12} =													519.34	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	6.22	7.41	6.3	0	0	0	0		
Total = Sum(221) _{6..8} =													19.94	(221)

Annual totals

Space heating fuel used, main system 1

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

kWh/year

kWh/year

1886.25

519.34

19.94

173.77

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

173.77

364.52

-769.49

2194.33

(230a)

(231)

(232)

(233)

(338)

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	0.519	= 978.96 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 269.54 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1248.5 (265)
Space cooling	(221) x	0.519	= 10.35 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 90.19 (267)
Electricity for lighting	(232) x	0.519	= 189.18 (268)
Energy saving/generation technologies Item 1		0.519	= -399.36 (269)
Total CO2, kg/year		sum of (265)...(271) =	1138.86 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.24 (273)
El rating (section 14)			88 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-01-05

Address : B-01-05, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	98	(1a) x	2.5	(2a) =	245 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			245 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			5.97	x 1/[1/(1.2)+0.04]	= 6.84		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Floor Type 1			30.8	x 0.1	= 3.08		(28)
Floor Type 2			44.7	x 0.15	= 6.705		(28)
Walls	42.28	14.32	27.96	x 0.18	= 5.03		(29)
Total area of elements, m²			117.78				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 31.32 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.38 (36)

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

Total fabric heat loss (33) + (36) = 33.7 (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=	22.64	22.39	22.13	20.84	20.58	19.29	19.29	19.04	19.81	20.58	21.1	21.61

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

(39)m=	56.34	56.08	55.83	54.54	54.28	52.99	52.99	52.73	53.51	54.28	54.8	55.31
Average = Sum(39) _{1...12} /12=												54.47 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56		
	Average = Sum(40) _{1...12} /12=												0.56	(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

2.72

(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

98.81

(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=	108.69	104.73	100.78	96.83	92.88	88.92	88.92	92.88	96.83	100.78	104.73	108.69		
	Total = Sum(44) _{1...12} =												1185.66	(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=	161.18	140.97	145.47	126.82	121.69	105.01	97.3	111.66	112.99	131.68	143.74	156.09		
	Total = Sum(45) _{1...12} =												1554.59	(45)

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

(46)m=	24.18	21.15	21.82	19.02	18.25	15.75	14.6	16.75	16.95	19.75	21.56	23.41		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04	(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=	188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04	
Output from water heater (annual) _{1...12}												1871.92	(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=	53.59	46.87	48.37	42.17	40.46	34.91	32.35	37.13	37.57	43.78	47.79	51.9	(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=	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	(66)

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

(67)m=	24.77	22	17.89	13.54	10.12	8.55	9.24	12	16.11	20.46	23.88	25.45	(67)

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

(68)m=	253.05	255.68	249.06	234.97	217.19	200.48	189.31	186.69	193.31	207.39	225.17	241.89	(68)

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

(69)m=	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	(71)

Water heating gains (Table 5)

(72)m=	72.03	69.75	65.01	58.57	54.38	48.49	43.49	49.9	52.18	58.85	66.38	69.76	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	413.65	411.23	395.76	370.89	345.5	321.32	305.84	312.4	325.4	350.5	379.24	400.9	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.13	x	10.63	x	0.4	x	0.7	=	13.18	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	25.2	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	42.81	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	68.77	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	92.64	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	99.18	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	92.59	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	73.46	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	51.48	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	29.99	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	16.26	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	10.99	(74)
South	0.9x	0.77	x	5.97	x	46.75	x	0.4	x	0.7	=	54.16	(78)
South	0.9x	0.77	x	5.97	x	76.57	x	0.4	x	0.7	=	88.7	(78)
South	0.9x	0.77	x	5.97	x	97.53	x	0.4	x	0.7	=	112.99	(78)
South	0.9x	0.77	x	5.97	x	110.23	x	0.4	x	0.7	=	127.7	(78)
South	0.9x	0.77	x	5.97	x	114.87	x	0.4	x	0.7	=	133.07	(78)
South	0.9x	0.77	x	5.97	x	110.55	x	0.4	x	0.7	=	128.06	(78)
South	0.9x	0.77	x	5.97	x	108.01	x	0.4	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	5.97	x	104.89	x	0.4	x	0.7	=	121.51	(78)
South	0.9x	0.77	x	5.97	x	101.89	x	0.4	x	0.7	=	118.03	(78)
South	0.9x	0.77	x	5.97	x	82.59	x	0.4	x	0.7	=	95.67	(78)
South	0.9x	0.77	x	5.97	x	55.42	x	0.4	x	0.7	=	64.2	(78)
South	0.9x	0.77	x	5.97	x	40.4	x	0.4	x	0.7	=	46.8	(78)

Solar gains in watts, calculated for each month

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

(83)m=	67.34	113.89	155.8	196.47	225.71	227.24	217.72	194.97	169.5	125.66	80.46	57.79	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	481	525.12	551.56	567.36	571.21	548.56	523.55	507.37	494.9	476.16	459.7	458.69	(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=	0.97	0.96	0.93	0.87	0.76	0.59	0.44	0.47	0.68	0.87	0.95	0.97	(86)

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

(87)m=	19.92	20.09	20.32	20.62	20.84	20.96	20.99	20.99	20.92	20.66	20.26	19.9	(87)

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

(88)m=	20.71	20.71	20.72	20.72	20.72	20.73	20.73	20.73	20.73	20.72	20.72	20.72	(88)

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

(89)m=	0.97	0.95	0.92	0.86	0.75	0.57	0.41	0.44	0.66	0.87	0.95	0.97	(89)

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

(90)m=	18.97	19.21	19.55	19.97	20.28	20.44	20.48	20.48	20.4	20.04	19.47	18.94	(90)

fLA = Living area ÷ (4) =

0.33 (91)

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

(92)m=	19.28	19.49	19.8	20.18	20.46	20.61	20.64	20.64	20.57	20.24	19.72	19.25	(92)

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

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(93)m=	19.28	19.49	19.8	20.18	20.46	20.61	20.64	20.64	20.57	20.24	19.72	19.25	(93)

8. Space heating requirement

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=	0.96	0.94	0.91	0.84	0.73	0.56	0.4	0.43	0.65	0.85	0.93	0.96	(94)

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

(95)m=	460.64	493.28	500.82	478.7	417.97	305.88	211.86	220.43	320.83	404.36	429.81	441.93	(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 , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	843.91	818.47	742.48	615.37	475.46	318.62	214.32	223.76	346.16	523.45	691.74	832.6	(97)

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

(98)m=	285.15	218.53	179.79	98.4	42.77	0	0	0	0	88.61	188.59	290.66	
Total per year ($kWh/year$) = $Sum(98)_{1..12} =$												1392.5	(98)

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

14.21	(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

Heat loss rate L_m (calculated using $25^\circ C$ internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	498.12	392.13	400.77	0	0	0	0	(100)

Utilisation factor for loss h_m

(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0	(101)

Useful loss, $h_m L_m$ (Watts) = $(100)m \times (101)m$

(102)m=	0	0	0	0	0	466.54	379.04	385.28	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	743.13	712.05	694.89	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$
set $(104)m$ to zero if $(104)m < 3 \times (98)m$

(104)m=	0	0	0	0	0	199.14	247.76	230.35	0	0	0	0	
Total = $Sum(104) =$												677.25	(104)
Cooled fraction $f_C = \text{cooled area} \div (4) =$												0.36	(105)

Intermittency factor (Table 10b)

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

Space cooling requirement for month = $(104)m \times (105) \times (106)m$

(107)m=	0	0	0	0	0	17.78	22.12	20.57	0	0	0	0	
Total = $Sum(107) =$												60.47	(107)

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

$(107) \div (4) =$	0.62	(108)

9a. Energy requirements – 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)

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Efficiency of main space heating system 1	100	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Cooling System Energy Efficiency Ratio	4.32	(209)

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

Space heating requirement (calculated above)

285.15	218.53	179.79	98.4	42.77	0	0	0	0	88.61	188.59	290.66

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

285.15	218.53	179.79	98.4	42.77	0	0	0	0	88.61	188.59	290.66

Total (kWh/year) = Sum(211)_{1..5,10...12} = 1392.5 (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	0

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

Water heating

Output from water heater (calculated above)

188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04

Efficiency of water heater	348.2	(216)

(217)m=	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

54.03	47.48	49.52	43.91	42.69	37.65	35.68	39.81	39.94	45.56	48.77	52.57

Total = Sum(219a)_{1..12} = 537.59 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=

0	0	0	0	0	4.12	5.12	4.76	0	0	0	0

Total = Sum(221)_{6...8} = 14 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	1392.5	
Water heating fuel used	537.59	
Space cooling fuel used	14	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside	198.02	(230a)

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	198.02	(231)

Electricity for lighting	437.37	(232)

Electricity generated by PVs	-876.57	(233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1702.91	(338)

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		0.519	=	722.71 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)

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Water heating	(219) x	0.519	=	279.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1001.72	(265)
Space cooling	(221) x	0.519	=	7.26	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	102.77	(267)
Electricity for lighting	(232) x	0.519	=	227	(268)
Energy saving/generation technologies Item 1		0.519	=	-454.94	(269)
Total CO2, kg/year		sum of (265)...(271) =		883.81	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		9.02	(273)
El rating (section 14)				92	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-02-01

Address : B-02-01, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.5 (2a)	185 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	185 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x 1/[1/(1.2)+ 0.04]	= 2.44		(27)
Walls	84.32	12.68	71.64	x 0.18	= 12.9		(29)
Total area of elements, m²			84.32				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 27.52 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.25 (36)

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

Total fabric heat loss (33) + (36) = 29.77 (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=	17.1	16.9	16.71	15.74	15.54	14.57	14.57	14.37	14.96	15.54	15.93	16.32

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

(39)m= 46.87 46.67 46.48 45.5 45.31 44.34 44.34 44.14 44.73 45.31 45.7 46.09 (39)

Average = Sum(39)_{1...12} /12= 45.46 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.63	0.63	0.63	0.61	0.61	0.6	0.6	0.6	0.6	0.61	0.62	0.62		
Average = Sum(40) _{1...12} /12=													0.61	(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

2.34

(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

89.76

(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=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(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=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	(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=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	
Output from water heater (annual) _{1...12}												1729.54	(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=	48.68	42.58	43.94	38.31	36.76	31.72	29.39	33.73	34.13	39.77	43.42	47.15	(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=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	19.6	17.41	14.16	10.72	8.01	6.76	7.31	9.5	12.75	16.19	18.9	20.14	(67)

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)

Water heating gains (Table 5)

(72)m=	65.43	63.36	59.06	53.2	49.4	44.05	39.5	45.33	47.4	53.46	60.3	63.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	349.57	347.45	334.49	313.71	292.69	272.46	259.35	265.22	275.94	296.93	320.99	338.94	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62 (76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12 (76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16 (76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88 (76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31 (76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

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

(83)m= 52.06 95.69 145.78 199.37 235.98 238.66 228.35 201.16 164.77 110.12 63.72 43.62 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 401.63 443.13 480.27 513.08 528.67 511.12 487.7 466.38 440.71 407.05 384.71 382.56 (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=	0.96	0.94	0.91	0.83	0.7	0.53	0.39	0.43	0.64	0.85	0.94	0.97

(86)

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

(87)m= 19.84 20.02 20.3 20.63 20.85 20.96 20.99 20.99 20.92 20.63 20.19 19.81 (87)

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

(88)m=	20.68	20.68	20.69	20.69	20.69	20.7	20.7	20.7	20.7	20.69	20.69	20.69	(88)

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

(89)m=	0.96	0.94	0.9	0.82	0.69	0.51	0.37	0.4	0.62	0.84	0.94	0.97	(89)

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

(90)m=	18.81	19.08	19.47	19.94	20.24	20.4	20.42	20.42	20.34	19.96	19.33	18.77	(90)

fLA = Living area ÷ (4) =	0.35	(91)

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

(92)m=	19.16	19.4	19.76	20.18	20.45	20.59	20.62	20.62	20.54	20.19	19.63	19.13	(92)

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

(93)m=	19.16	19.4	19.76	20.18	20.45	20.59	20.62	20.62	20.54	20.19	19.63	19.13	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.95	0.93	0.88	0.8	0.67	0.5	0.36	0.39	0.61	0.83	0.92	0.95	(94)

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

(95)m=	380.64	410.18	424.4	410.78	355.84	256.57	176.41	183.64	268.14	336.4	354.9	365.14	(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=	696.63	676.85	616.25	513.28	396.64	265.67	178.26	186.25	288.23	434.74	572.69	688.16	(97)

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

(98)m=	235.09	179.2	142.74	73.8	30.35	0	0	0	0	73.17	156.8	240.33	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1131.49	(98)

Space heating requirement in kWh/m²/year

15.29	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	416.77	328.09	335.48	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	393.25	318.04	323.16	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	682.18	653.36	629.68	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	208.03	249.48	228.05	0	0	0	0	
Total = Sum(104) =												685.56	(104)

Cooled fraction

f C = cooled area ÷ (4) =	0.47	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	24.6	29.5	26.97	0	0	0	0		
													Total = Sum(107) =	81.06 (107)
Space cooling requirement in kWh/m ² /year													(107) ÷ (4) =	1.1 (108)

9a. Energy requirements – 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		100 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)
Cooling System Energy Efficiency Ratio		4.32 (209)

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

Space heating requirement (calculated above)

235.09	179.2	142.74	73.8	30.35	0	0	0	0	73.17	156.8	240.33	
(211)m = {[(98)m × (204)] } × 100 ÷ (206)												(211)
235.09	179.2	142.74	73.8	30.35	0	0	0	0	73.17	156.8	240.33	
Total (kWh/year) = Sum(211) _{1..5,10...12} =												1131.49 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 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)

173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	
Efficiency of water heater												349.41 (216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m												
(219)m=	49.62	43.62	45.53	40.44	39.35	34.76	33.01	36.74	36.84	41.95	44.83	48.29
Total = Sum(219a) _{1..12} =												494.99 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)												
(221)m=	0	0	0	0	0	5.69	6.83	6.24	0	0	0	0
Total = Sum(221) _{6..8} =												18.76 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		1131.49
Water heating fuel used		494.99
Space cooling fuel used		18.76
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	141.06	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	141.06 (231)

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Electricity for lighting	346.14	(232)
Electricity generated by PVs	-662.4	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1470.05	(338)

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	0.519	=	587.24	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	256.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			844.14	(265)
Space cooling	(221) x	0.519	=	9.74	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	73.21	(267)
Electricity for lighting	(232) x	0.519	=	179.65	(268)
Energy saving/generation technologies Item 1		0.519	=	-343.78	(269)
Total CO2, kg/year		sum of (265)...(271) =		762.96	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.31	(273)
El rating (section 14)				91	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-02-02

Address : B-02-02, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50 (1a)	2.5 (2a)	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			1.63	x1/[1/(1.2)+ 0.04]	= 1.87		(27)
Walls	54.62	12.18	42.44	x 0.18	= 7.64		(29)
Total area of elements, m²			54.62				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 21.69 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.41 (36)

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

Total fabric heat loss (33) + (36) = 24.11 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m= 35.66 35.53 35.4 34.74 34.61 33.95 33.95 33.82 34.21 34.61 34.87 35.13
Average = Sum(39)_{1...12} /12= 34.71 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.71	0.71	0.71	0.69	0.69	0.68	0.68	0.68	0.68	0.69	0.7	0.7		
Average = Sum(40) _{1...12} /12=													0.69	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
Total = Sum(44) _{1...12} =													892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
Total = Sum(45) _{1...12} =													1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.19	11.72	9.53	7.21	5.39	4.55	4.92	6.39	8.58	10.9	12.72	13.56	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.97	261.31	251.7	236.34	221.03	206.03	196.14	200.91	208.66	224.19	242.03	255.13	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.63	x	46.75	x	0.4	x	0.7	=	14.79	(78)
South	0.9x	0.77	x	1.63	x	76.57	x	0.4	x	0.7	=	24.22	(78)
South	0.9x	0.77	x	1.63	x	97.53	x	0.4	x	0.7	=	30.85	(78)
South	0.9x	0.77	x	1.63	x	110.23	x	0.4	x	0.7	=	34.87	(78)
South	0.9x	0.77	x	1.63	x	114.87	x	0.4	x	0.7	=	36.33	(78)

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South	0.9x	0.77	x	1.63	x	110.55	x	0.4	x	0.7	=	34.96	(78)
South	0.9x	0.77	x	1.63	x	108.01	x	0.4	x	0.7	=	34.16	(78)
South	0.9x	0.77	x	1.63	x	104.89	x	0.4	x	0.7	=	33.18	(78)
South	0.9x	0.77	x	1.63	x	101.89	x	0.4	x	0.7	=	32.22	(78)
South	0.9x	0.77	x	1.63	x	82.59	x	0.4	x	0.7	=	26.12	(78)
South	0.9x	0.77	x	1.63	x	55.42	x	0.4	x	0.7	=	17.53	(78)
South	0.9x	0.77	x	1.63	x	40.4	x	0.4	x	0.7	=	12.78	(78)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m= 47.52 88.26 136.31 188.68 224.84 227.93 217.87 190.98 154.88 102.11 58.35 39.7 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 310.5 349.56 388.02 425.02 445.86 433.97 414.01 391.89 363.55 326.3 300.37 294.83 (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=	0.95	0.93	0.88	0.78	0.64	0.48	0.36	0.39	0.6	0.82	0.93	0.96

(86)

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

(87)m= 19.74 19.95 20.27 20.63 20.85 20.96 20.99 20.99 20.92 20.61 20.12 19.7 (87)

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

(88)m=	20.64	20.64	20.65	20.65	20.65	20.66	20.66	20.66	20.66	20.65	20.65	20.65	(88)

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

(89)m=	0.95	0.92	0.87	0.77	0.63	0.46	0.33	0.36	0.57	0.81	0.92	0.96	(89)

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

(90)m=	18.62	18.93	19.38	19.88	20.18	20.32	20.35	20.35	20.27	19.87	19.18	18.57	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	19.12	19.39	19.78	20.22	20.49	20.61	20.64	20.64	20.56	20.21	19.61	19.08	(92)

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

(93)m=	19.12	19.39	19.78	20.22	20.49	20.61	20.64	20.64	20.56	20.21	19.61	19.08	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.93	0.9	0.85	0.75	0.62	0.46	0.33	0.36	0.57	0.79	0.9	0.94	(94)

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

(95)m=	289.8	316.19	330.44	320.49	275.63	197.49	135.73	141.26	205.98	258.9	271.36	277.6	(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=	528.63	514.94	470.22	393.16	304.06	204.19	137.24	143.4	221.17	332.48	436.28	522.82	(97)

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

(98)m=	177.69	133.56	103.99	52.33	21.15	0	0	0	0	54.75	118.74	182.44	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												844.65	(98)

Space heating requirement in kWh/m²/year

16.89	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	319.13	251.23	257.02	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.95	0.97	0.96	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	301.77	243.46	247.32	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	569.01	544.71	519.51	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	192.42	224.12	202.51	0	0	0	0	
Total = Sum(104) =												619.05	(104)

Cooled fraction	f C = cooled area ÷ (4) =	0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	33.67	39.22	35.44	0	0	0	0		
													Total = Sum(107) =	108.33 (107)
Space cooling requirement in kWh/m ² /year													(107) ÷ (4) =	2.17 (108)

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

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

Space heating requirement (calculated above)

	177.69	133.56	103.99	52.33	21.15	0	0	0	0	54.75	118.74	182.44		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	177.69	133.56	103.99	52.33	21.15	0	0	0	0	54.75	118.74	182.44		
													Total (kWh/year) = Sum(211) _{1..5,10...12} =	844.65 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)														
(215)m=	0	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)

	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32		
													Total = Sum(219a) _{1..12} =	425.57 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	7.79	9.08	8.2	0	0	0	0		
													Total = Sum(221) _{6..8} =	25.08 (221)

Annual totals

		kWh/year	kWh/year
Space heating fuel used, main system 1			844.65
Water heating fuel used			425.57
Space cooling fuel used			25.08
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		95.31 (231)

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Electricity for lighting	232.95	(232)
Electricity generated by PVs	-447.36	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1176.21	(338)

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	0.519	=	438.37	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			659.25	(265)
Space cooling	(221) x	0.519	=	13.02	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Energy saving/generation technologies Item 1		0.519	=	-232.18	(269)
Total CO2, kg/year		sum of (265)...(271) =		610.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.21	(273)
El rating (section 14)				91	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-02-03

Address : B-02-03, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total		m ³ per hour
Number of chimneys	0	+	0	+	0	x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	37.97	10.55	27.42	x 0.18	= 4.94		(29)
Total area of elements, m²			37.97				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 17.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 1.72 (36)

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

Total fabric heat loss (33) + (36) = 18.84 (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=	10.96	10.84	10.72	10.12	10	9.4	9.4	9.28	9.64	10	10.24	10.48

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

(39)m= 29.8 29.69 29.57 28.97 28.85 28.25 28.25 28.13 28.49 28.85 29.09 29.33
Average = Sum(39)_{1...12} /12= 28.94 (39)

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

(40)m= 0.6 0.59 0.59 0.58 0.58 0.56 0.56 0.56 0.57 0.58 0.58 0.59
Average = Sum(40)_{1...12} /12= 0.58 (40)

DER WorkSheet: New dwelling design stage

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

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

1.69

(42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

74.34

(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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	
Total = Sum(44) _{1...12} =												892.08	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Total = Sum(45) _{1...12} =												1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62	(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

DER WorkSheet: New dwelling design stage

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=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

 (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	0

 (63)

Output from water heater

(64)m=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Output from water heater (annual)_{1...12}

1486.99

 (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=

40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51

 (66)

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

(67)m=

13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89

 (67)

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

(68)m=

147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74

 (68)

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

(69)m=

31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

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

(71)m=

-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6

 (71)

Water heating gains (Table 5)

(72)m=

54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>24.62</td></tr></table> (80)	24.62
0.77																		
6.46																		
19.64																		
0.4																		
0.7																		
24.62																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>8.12</td></tr></table> (80)	8.12
0.77																		
2.13																		
19.64																		
0.4																		
0.7																		
8.12																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>48.16</td></tr></table> (80)	48.16
0.77																		
6.46																		
38.42																		
0.4																		
0.7																		
48.16																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>15.88</td></tr></table> (80)	15.88
0.77																		
2.13																		
38.42																		
0.4																		
0.7																		
15.88																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>79.31</td></tr></table> (80)	79.31
0.77																		
6.46																		
63.27																		
0.4																		
0.7																		
79.31																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>26.15</td></tr></table> (80)	26.15
0.77																		
2.13																		
63.27																		
0.4																		
0.7																		
26.15																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>115.67</td></tr></table> (80)	115.67
0.77																		
6.46																		
92.28																		
0.4																		
0.7																		
115.67																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>38.14</td></tr></table> (80)	38.14
0.77																		
2.13																		
92.28																		
0.4																		
0.7																		
38.14																		

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m=	32.74	64.04	105.46	153.81	188.5	192.97	183.71	157.81	122.66	75.99	40.82	26.92	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	296.03	325.63	357.4	390.33	409.66	399.11	379.97	358.87	331.53	300.45	283.15	282.38	(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=	0.95	0.92	0.87	0.76	0.61	0.44	0.33	0.36	0.56	0.81	0.92	0.96	(86)

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

(87)m=	20.04	20.22	20.48	20.76	20.92	20.98	21	21	20.96	20.74	20.36	20.01	(87)

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

(88)m=	20.7	20.7	20.7	20.71	20.71	20.72	20.72	20.72	20.72	20.71	20.71	20.71	(88)

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

(89)m=	0.95	0.92	0.86	0.75	0.6	0.43	0.3	0.34	0.54	0.8	0.91	0.95	(89)

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

(90)m=	19.13	19.38	19.75	20.15	20.36	20.45	20.46	20.46	20.41	20.14	19.6	19.09	(90)

fLA = Living area ÷ (4) =

0.45

(91)

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

(92)m=	19.54	19.76	20.08	20.43	20.62	20.69	20.7	20.7	20.66	20.41	19.94	19.51	(92)

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

(93)m=	19.54	19.76	20.08	20.43	20.62	20.69	20.7	20.7	20.66	20.41	19.94	19.51	(93)

8. 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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.93	0.9	0.85	0.74	0.59	0.42	0.3	0.34	0.54	0.78	0.9	0.94	(94)

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

(95)m=	276.02	294.66	303.44	288.84	242.39	169.34	115.4	120.27	179.4	235.3	254.94	265.6	(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=	454.28	441.09	401.58	333.97	257.18	172.05	115.9	121.03	186.91	283.02	373.55	448.9	(97)

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

(98)m=	132.62	98.4	73.02	32.5	11.01	0	0	0	0	35.5	85.4	136.38	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												604.82	(98)

Space heating requirement in kWh/m²/year

12.1	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	265.52	209.02	213.76	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.97	0.99	0.98	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	258.37	206.18	210.06	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	528.42	505.08	481.12	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	194.43	222.38	201.67	0	0	0	0	
Total = Sum(104) =												618.48	(104)
Cooled fraction f C = cooled area ÷ (4) =												0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Total = Sum(104) =												0	(106)

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

(107)m=	0	0	0	0	0	34.03	38.92	35.29	0	0	0	0	
Total = Sum(107) =												108.23	(107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) =	2.16	(108)

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	132.62	98.4	73.02	32.5	11.01	0	0	0	0	35.5	85.4	136.38	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)													
	132.62	98.4	73.02	32.5	11.01	0	0	0	0	35.5	85.4	136.38	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													604.82 (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	0	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Efficiency of water heater													349.41 (216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41 (217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32	
Total = Sum(219a) _{1..12} =													425.57 (219)
Space cooling fuel, kWh/month.													
(221)m = (107)m ÷ (209)													
(221)m=	0	0	0	0	0	7.88	9.01	8.17	0	0	0	0	
Total = Sum(221) _{6..8} =													25.05 (221)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													604.82
Water heating fuel used													425.57
Space cooling fuel used													25.05
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													95.31 (230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												95.31 (231)
Electricity for lighting													238.63 (232)
Electricity generated by PVs													-447.36 (233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													942.04 (338)

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	0.519	313.9 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	220.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		534.77 (265)

DER WorkSheet: New dwelling design stage

Space cooling	(221) x	0.519	=	13	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Energy saving/generation technologies Item 1		0.519	=	-232.18	(269)
Total CO2, kg/year		sum of (265)...(271) =		488.92	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		9.78	(273)
El rating (section 14)				93	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-02-04

Address : B-02-04, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	86	(1a) x	2.5	(2a) =	215 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			215 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 4			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Walls	70.93	23.33	47.6	x 0.18	= 8.57		(29)
Total area of elements, m²			70.93				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 35.39 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.53 (36)

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

Total fabric heat loss (33) + (36) = 38.92 (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=	19.87	19.64	19.42	18.29	18.06	16.93	16.93	16.7	17.38	18.06	18.51	18.97

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

(39)m=	58.79	58.56	58.33	57.2	56.98	55.85	55.85	55.62	56.3	56.98	57.43	57.88
Average = Sum(39) _{1...12} /12=												57.15 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.68	0.68	0.68	0.67	0.66	0.65	0.65	0.65	0.65	0.66	0.67	0.67		
	Average = Sum(40) _{1...12} /12=												0.66	(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

2.57

(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

95.16

(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=	104.68	100.87	97.07	93.26	89.45	85.65	85.65	89.45	93.26	97.07	100.87	104.68		
	Total = Sum(44) _{1...12} =												1141.97	(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=	155.24	135.77	140.11	122.15	117.2	101.14	93.72	107.54	108.83	126.83	138.44	150.34		
	Total = Sum(45) _{1...12} =												1497.31	(45)

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

(46)m=	23.29	20.37	21.02	18.32	17.58	15.17	14.06	16.13	16.32	19.02	20.77	22.55		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	201	(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):	0.54	(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.19	160.12	167.06	148.23	144.15	127.22	120.67	134.49	134.91	153.78	164.53	177.29	(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=	182.19	160.12	167.06	148.23	144.15	127.22	120.67	134.49	134.91	153.78	164.53	177.29	
Output from water heater (annual) _{1...12}												1814.64	(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=	51.62	45.14	46.58	40.61	38.97	33.63	31.16	35.76	36.19	42.17	46.03	49.99	(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=	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	128.35	(66)

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

(67)m=	20.64	18.33	14.91	11.29	8.44	7.12	7.7	10	13.43	17.05	19.9	21.21	(67)

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

(68)m=	231.52	233.93	227.87	214.98	198.71	183.42	173.21	170.8	176.86	189.75	206.02	221.31	(68)

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

(69)m=	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	35.83	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	-102.68	(71)

Water heating gains (Table 5)

(72)m=	69.38	67.18	62.61	56.41	52.38	46.71	41.88	48.06	50.26	56.68	63.93	67.19	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	383.05	380.94	366.9	344.18	321.03	298.75	284.29	290.37	302.05	324.98	351.35	371.21	(73)

6. Solar gains:

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

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	2.13	x	10.63	x	0.4	x	0.7	=	21.97	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	41.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	71.36	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	114.62	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	154.4	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	165.29	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	154.32	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	122.43	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	85.8	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	49.99	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	27.11	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	18.32	(74)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)

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West $0.9 \times \boxed{0.77} \times \boxed{6.46} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.7} = \boxed{20.25}$ (80)

West $0.9 \times \boxed{0.77} \times \boxed{2.13} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.7} = \boxed{6.68}$ (80)

Solar gains in watts, calculated for each month

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

(83)m=

74.03	137.68	217.13	313.99	390.38	403.95	382.68	323.59	250.56	160.11	90.83	61.94

 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=

457.08	518.62	584.03	658.17	711.42	702.7	666.97	613.97	552.61	485.09	442.19	433.15

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.97	0.95	0.91	0.81	0.66	0.49	0.36	0.41	0.64	0.86	0.95	0.97

 (86)

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

(87)m=

19.66	19.88	20.21	20.6	20.85	20.97	20.99	20.99	20.91	20.56	20.06	19.63

 (87)

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

(88)m=

20.66	20.66	20.66	20.67	20.67	20.68	20.68	20.68	20.67	20.67	20.67	20.66

 (88)

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

(89)m=

0.97	0.95	0.9	0.8	0.65	0.47	0.34	0.38	0.61	0.85	0.95	0.97

 (89)

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

(90)m=

18.53	18.84	19.32	19.87	20.21	20.35	20.38	20.38	20.29	19.83	19.11	18.48

 (90)

fLA = Living area ÷ (4) =

0.17

 (91)

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

(92)m=

18.72	19.02	19.47	20	20.32	20.46	20.48	20.48	20.39	19.96	19.27	18.68

 (92)

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

(93)m=

18.72	19.02	19.47	20	20.32	20.46	20.48	20.48	20.39	19.96	19.27	18.68

 (93)

8. 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

Utilisation factor for gains, hm:

(94)m=

0.95	0.93	0.88	0.78	0.63	0.45	0.32	0.36	0.59	0.83	0.93	0.96

 (94)

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

(95)m=

434.55	480.28	512.23	511.03	446.14	317.66	214.93	223.91	327.96	401.19	409.64	414.76

 (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=

847.79	826.88	756.71	634.79	490.93	327.09	216.87	227	354.18	533.06	698.8	838.07

 (97)

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

(98)m=

307.45	232.91	181.89	89.11	33.32	0	0	0	0	98.11	208.2	314.94

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1465.94

 (98)

Space heating requirement in kWh/m²/year

17.05

 (99)

8c. Space cooling requirement

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	524.96	413.27	422.72	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	496.7	400.64	405.64	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	914.73	871.23	810.54	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m													
set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	300.98	350.12	301.24	0	0	0	0	
									Total = Sum(104) =		952.34		(104)
Cooled fraction									f C = cooled area ÷ (4) =		0.41		(105)
Intermittency factor (Table 10b)													
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
									Total = Sum(104) =		0		(106)
Space cooling requirement for month = (104)m × (105) × (106)m													
(107)m=	0	0	0	0	0	30.62	35.62	30.65	0	0	0	0	
									Total = Sum(107) =		96.9		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		1.13		(108)

9a. Energy requirements – 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) x [1 – (203)] =												1 (204)
Efficiency of main space heating system 1													100 (206)
Efficiency of secondary/supplementary heating system, %													0 (208)
Cooling System Energy Efficiency Ratio													4.32 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	307.45	232.91	181.89	89.11	33.32	0	0	0	0	98.11	208.2	314.94	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													
	307.45	232.91	181.89	89.11	33.32	0	0	0	0	98.11	208.2	314.94	
Total (kWh/year) = Sum(211) _{1...5,10...12} =												1465.94	(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	0	
Total (kWh/year) = Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)	182.19	160.12	167.06	148.23	144.15	127.22	120.67	134.49	134.91	153.78	164.53	177.29	
Efficiency of water heater													349.41 (216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	52.14	45.82	47.81	42.42	41.26	36.41	34.54	38.49	38.61	44.01	47.09	50.74		
Total = Sum(219a) _{1..12} =													519.34	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	7.09	8.25	7.09	0	0	0	0		
Total = Sum(221) _{6..8} =													22.43	(221)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Space cooling fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

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

Electricity for lighting

Electricity generated by PVs

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

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	0.519	=	760.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	269.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1030.36	(265)
Space cooling	(221) x	0.519	=	11.64	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	90.19	(267)
Electricity for lighting	(232) x	0.519	=	189.18	(268)
Energy saving/generation technologies Item 1		0.519	=	-399.36	(269)
Total CO2, kg/year			sum of (265)...(271) =	922.01	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	10.72	(273)
EI rating (section 14)				91	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-02-05

Address : B-02-05, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	98	(1a) x	2.5	(2a) =	245 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			245 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			5.97	x 1/[1/(1.2)+0.04]	= 6.84		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	42.28	14.32	27.96	x 0.18	= 5.03		(29)
Total area of elements, m²			42.28				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 21.54 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.38 (36)

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

Total fabric heat loss (33) + (36) = 23.91 (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=	22.64	22.39	22.13	20.84	20.58	19.29	19.29	19.04	19.81	20.58	21.1	21.61

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

(39)m= 46.56 46.3 46.04 44.75 44.49 43.21 43.21 42.95 43.72 44.49 45.01 45.53
Average = Sum(39)_{1...12} /12= 44.69 (39)

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

(40)m= 0.48 0.47 0.47 0.46 0.45 0.44 0.44 0.44 0.45 0.45 0.46 0.46
Average = Sum(40)_{1...12} /12= 0.46 (40)

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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 2.72 (42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ 98.81 (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 $V_{d,m}$ = factor from Table 1c x (43)													
(44)m=	108.69	104.73	100.78	96.83	92.88	88.92	88.92	92.88	96.83	100.78	104.73	108.69	
Total = Sum(44) _{1...12} =												1185.66	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	161.18	140.97	145.47	126.82	121.69	105.01	97.3	111.66	112.99	131.68	143.74	156.09	
Total = Sum(45) _{1...12} =												1554.59	(45)

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

(46)m=	24.18	21.15	21.82	19.02	18.25	15.75	14.6	16.75	16.95	19.75	21.56	23.41	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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	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	0	(61)

DER WorkSheet: New dwelling design stage

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=

188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04

 (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	0

 (63)

Output from water heater

(64)m=

188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04

Output from water heater (annual)_{1...12}

1871.92

 (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=

53.59	46.87	48.37	42.17	40.46	34.91	32.35	37.13	37.57	43.78	47.79	51.9

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01

 (66)

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

(67)m=

24.77	22	17.89	13.54	10.12	8.55	9.24	12	16.11	20.46	23.88	25.45

 (67)

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

(68)m=

253.05	255.68	249.06	234.97	217.19	200.48	189.31	186.69	193.31	207.39	225.17	241.89

 (68)

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

(69)m=

36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

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

(71)m=

-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81

 (71)

Water heating gains (Table 5)

(72)m=

72.03	69.75	65.01	58.57	54.38	48.49	43.49	49.9	52.18	58.85	66.38	69.76

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

413.65	411.23	395.76	370.89	345.5	321.32	305.84	312.4	325.4	350.5	379.24	400.9

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>10.63</td></tr></table>	10.63	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>13.18</td></tr></table> (74)	13.18
0.77																		
2.13																		
10.63																		
0.4																		
0.7																		
13.18																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>20.32</td></tr></table>	20.32	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>25.2</td></tr></table> (74)	25.2
0.77																		
2.13																		
20.32																		
0.4																		
0.7																		
25.2																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>34.53</td></tr></table>	34.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>42.81</td></tr></table> (74)	42.81
0.77																		
2.13																		
34.53																		
0.4																		
0.7																		
42.81																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>55.46</td></tr></table>	55.46	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>68.77</td></tr></table> (74)	68.77
0.77																		
2.13																		
55.46																		
0.4																		
0.7																		
68.77																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>74.72</td></tr></table>	74.72	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>92.64</td></tr></table> (74)	92.64
0.77																		
2.13																		
74.72																		
0.4																		
0.7																		
92.64																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>79.99</td></tr></table>	79.99	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>99.18</td></tr></table> (74)	99.18
0.77																		
2.13																		
79.99																		
0.4																		
0.7																		
99.18																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>74.68</td></tr></table>	74.68	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>92.59</td></tr></table> (74)	92.59
0.77																		
2.13																		
74.68																		
0.4																		
0.7																		
92.59																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>59.25</td></tr></table>	59.25	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>73.46</td></tr></table> (74)	73.46
0.77																		
2.13																		
59.25																		
0.4																		
0.7																		
73.46																		

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	51.48	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	29.99	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	16.26	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	10.99	(74)
South	0.9x	0.77	x	5.97	x	46.75	x	0.4	x	0.7	=	54.16	(78)
South	0.9x	0.77	x	5.97	x	76.57	x	0.4	x	0.7	=	88.7	(78)
South	0.9x	0.77	x	5.97	x	97.53	x	0.4	x	0.7	=	112.99	(78)
South	0.9x	0.77	x	5.97	x	110.23	x	0.4	x	0.7	=	127.7	(78)
South	0.9x	0.77	x	5.97	x	114.87	x	0.4	x	0.7	=	133.07	(78)
South	0.9x	0.77	x	5.97	x	110.55	x	0.4	x	0.7	=	128.06	(78)
South	0.9x	0.77	x	5.97	x	108.01	x	0.4	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	5.97	x	104.89	x	0.4	x	0.7	=	121.51	(78)
South	0.9x	0.77	x	5.97	x	101.89	x	0.4	x	0.7	=	118.03	(78)
South	0.9x	0.77	x	5.97	x	82.59	x	0.4	x	0.7	=	95.67	(78)
South	0.9x	0.77	x	5.97	x	55.42	x	0.4	x	0.7	=	64.2	(78)
South	0.9x	0.77	x	5.97	x	40.4	x	0.4	x	0.7	=	46.8	(78)

Solar gains in watts, calculated for each month

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

(83)m=	67.34	113.89	155.8	196.47	225.71	227.24	217.72	194.97	169.5	125.66	80.46	57.79	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	481	525.12	551.56	567.36	571.21	548.56	523.55	507.37	494.9	476.16	459.7	458.69	(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=	0.96	0.94	0.9	0.81	0.68	0.5	0.36	0.39	0.59	0.82	0.93	0.97	(86)

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

(87)m=	20.25	20.4	20.59	20.81	20.94	20.99	21	21	20.98	20.83	20.53	20.23	(87)

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

(88)m=	20.76	20.76	20.77	20.77	20.77	20.78	20.78	20.78	20.78	20.77	20.77	20.77	(88)

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

(89)m=	0.96	0.94	0.9	0.81	0.67	0.48	0.34	0.37	0.57	0.81	0.93	0.97	(89)

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

(90)m=	19.51	19.73	20	20.32	20.49	20.57	20.57	20.58	20.55	20.35	19.93	19.49	(90)

fLA = Living area ÷ (4) =

0.33

(91)

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

(92)m=	19.75	19.95	20.2	20.48	20.64	20.7	20.71	20.71	20.69	20.51	20.12	19.73	(92)

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

(93)m=	19.75	19.95	20.2	20.48	20.64	20.7	20.71	20.71	20.69	20.51	20.12	19.73	(93)

8. 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=	0.95	0.92	0.88	0.79	0.66	0.48	0.34	0.36	0.57	0.8	0.92	0.96	(94)

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

(95)m=	456.53	485.51	486.56	450.94	376.02	260.66	177.25	184.64	280.28	381.72	421.73	438.58	(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=	719.44	696.68	630.57	518.15	397.6	263.73	177.67	185.25	287.95	440.8	586.13	707.21	(97)

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

(98)m=	195.6	141.91	107.15	48.39	16.05	0	0	0	0	43.96	118.37	199.87	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

871.28

Space heating requirement in kWh/m²/year

8.89

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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	406.14	319.73	326.41	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.98	0.99	0.99	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	397.99	316.97	323.04	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	743.13	712.05	694.89	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 x (98)m

(104)m=	0	0	0	0	0	248.5	293.94	276.65	0	0	0	0	(104)

Total = Sum(104) =

819.1

Cooled fraction

f C = cooled area ÷ (4) =

0.36

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	(106)

Total = Sum(104) =

0

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

(107)m=	0	0	0	0	0	22.19	26.24	24.7	0	0	0	0	(107)

Total = Sum(107) =

73.13

Space cooling requirement in kWh/m²/year

(107) ÷ (4) =

0.75

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

Space heating:

Fraction of space heat from secondary/supplementary system

0

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1

Fraction of total heating from main system 1

(204) = (202) x [1 – (203)] =

1

Efficiency of main space heating system 1

100

Efficiency of secondary/supplementary heating system, %

0

Cooling System Energy Efficiency Ratio

4.32

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	195.6	141.91	107.15	48.39	16.05	0	0	0	0	43.96	118.37	199.87	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)													
	195.6	141.91	107.15	48.39	16.05	0	0	0	0	43.96	118.37	199.87	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													871.28 (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	0	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04	
Efficiency of water heater													348.2 (216)
(217)m=	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	348.2	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	54.03	47.48	49.52	43.91	42.69	37.65	35.68	39.81	39.94	45.56	48.77	52.57	
Total = Sum(219a) _{1..12} =													537.59 (219)
Space cooling fuel, kWh/month.													
(221)m = (107)m ÷ (209)													
(221)m=	0	0	0	0	0	5.14	6.08	5.72	0	0	0	0	
Total = Sum(221) _{6..8} =													16.93 (221)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													871.28
Water heating fuel used													537.59
Space cooling fuel used													16.93
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													198.02 (230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												198.02 (231)
Electricity for lighting													437.37 (232)
Electricity generated by PVs													-876.57 (233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													1184.63 (338)

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	0.519	452.2 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	279.01 (264)
Space and water heating	(261) + (262) + (263) + (264) =		731.21 (265)

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Space cooling	(221) x	0.519	=	8.79	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	102.77	(267)
Electricity for lighting	(232) x	0.519	=	227	(268)
Energy saving/generation technologies Item 1		0.519	=	-454.94	(269)
Total CO2, kg/year		sum of (265)...(271) =		614.82	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		6.27	(273)
El rating (section 14)				94	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-03-01

Address : B-03-01, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.5 (2a)	185 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	185 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	84.32	12.68	71.64	x 0.18	= 12.9		(29)
Roof	8.94	0	8.94	x 0.14	= 1.25		(30)
Total area of elements, m²			93.26				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.25 (36)

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

Total fabric heat loss (33) + (36) = 31.02 (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=	17.1	16.9	16.71	15.74	15.54	14.57	14.57	14.37	14.96	15.54	15.93	16.32

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

(39)m=	48.12	47.92	47.73	46.76	46.56	45.59	45.59	45.39	45.98	46.56	46.95	47.34
Average = Sum(39) _{1...12} /12=												46.71 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.65	0.65	0.64	0.63	0.63	0.62	0.62	0.61	0.62	0.63	0.63	0.64		
	Average = Sum(40) _{1...12} /12=												0.63	(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

2.34

(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

89.76

(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=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(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=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	(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=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	
Output from water heater (annual) _{1...12}												1729.54	(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=	48.68	42.58	43.94	38.31	36.76	31.72	29.39	33.73	34.13	39.77	43.42	47.15	(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=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	19.6	17.41	14.16	10.72	8.01	6.76	7.31	9.5	12.75	16.19	18.9	20.14	(67)

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)

Water heating gains (Table 5)

(72)m=	65.43	63.36	59.06	53.2	49.4	44.05	39.5	45.33	47.4	53.46	60.3	63.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	349.57	347.45	334.49	313.71	292.69	272.46	259.35	265.22	275.94	296.93	320.99	338.94	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

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

(83)m= 52.06 95.69 145.78 199.37 235.98 238.66 228.35 201.16 164.77 110.12 63.72 43.62 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 401.63 443.13 480.27 513.08 528.67 511.12 487.7 466.38 440.71 407.05 384.71 382.56 (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=	0.96	0.95	0.91	0.83	0.71	0.54	0.4	0.44	0.65	0.86	0.94	0.97

(86)

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

(87)m= 19.78 19.97 20.25 20.59 20.83 20.96 20.99 20.99 20.91 20.61 20.15 19.75 (87)

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

(88)m=	20.67	20.68	20.68	20.68	20.69	20.69	20.69	20.69	20.69	20.69	20.68	20.68	(88)

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

(89)m=	0.96	0.94	0.91	0.82	0.7	0.52	0.38	0.41	0.63	0.85	0.94	0.97	(89)

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

(90)m=	18.72	18.99	19.4	19.89	20.21	20.37	20.41	20.41	20.32	19.91	19.26	18.69	(90)

fLA = Living area ÷ (4) =	0.35	(91)

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

(92)m=	19.09	19.33	19.7	20.13	20.42	20.58	20.61	20.61	20.52	20.15	19.57	19.06	(92)

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

(93)m=	19.09	19.33	19.7	20.13	20.42	20.58	20.61	20.61	20.52	20.15	19.57	19.06	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.95	0.93	0.89	0.81	0.68	0.51	0.37	0.4	0.62	0.83	0.92	0.96	(94)

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

(95)m=	380.98	410.86	425.8	413.73	360.49	261.75	180.51	187.83	272.41	338.41	355.56	365.4	(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=	711.69	691.6	629.85	525.16	406.21	272.45	182.77	190.98	295.34	444.71	585.43	703.32	(97)

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

(98)m=	246.05	188.66	151.81	80.23	34.02	0	0	0	0	79.08	165.51	251.41	(98)

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1196.77	(98)

Space heating requirement in kWh/m²/year

16.17	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	428.53	337.36	344.99	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.94	0.96	0.96	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	401.12	325.37	330.38	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	682.18	653.36	629.68	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	202.37	244.03	222.68	0	0	0	0	(104)

Total = Sum(104) =	669.07	(104)

Cooled fraction

f C = cooled area ÷ (4) =	0.47	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	(106)

Total = Sum(104) =	0	(106)

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

(107)m=	0	0	0	0	0	23.93	28.85	26.33	0	0	0	0		
Total = Sum(107) =													79.11	(107)
Space cooling requirement in kWh/m ² /year													1.07	(108)
(107) ÷ (4) =														

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

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

Space heating requirement (calculated above)

	246.05	188.66	151.81	80.23	34.02	0	0	0	0	79.08	165.51	251.41		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	246.05	188.66	151.81	80.23	34.02	0	0	0	0	79.08	165.51	251.41		
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1196.77	(211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)														
(215)m=	0	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)

	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	49.62	43.62	45.53	40.44	39.35	34.76	33.01	36.74	36.84	41.95	44.83	48.29		
Total = Sum(219a) _{1..12} =													494.99	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	5.54	6.68	6.09	0	0	0	0		
Total = Sum(221) _{6..8} =													18.31	(221)

Annual totals

		kWh/year	kWh/year
Space heating fuel used, main system 1			1196.77
Water heating fuel used			494.99
Space cooling fuel used			18.31
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		141.06	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		141.06 (231)

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Electricity for lighting	346.14	(232)
Electricity generated by PVs	-662.4	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1534.88	(338)

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	0.519	=	621.12	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	256.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			878.02	(265)
Space cooling	(221) x	0.519	=	9.5	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	73.21	(267)
Electricity for lighting	(232) x	0.519	=	179.65	(268)
Energy saving/generation technologies Item 1		0.519	=	-343.78	(269)
Total CO2, kg/year		sum of (265)...(271) =		796.6	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.76	(273)
El rating (section 14)				91	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-03-05

Address : B-03-05, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	98 (1a)	2.5 (2a)	245 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	245 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			5.97	x1/[1/(1.2)+ 0.04]	= 6.84		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Walls	42.28	14.32	27.96	x 0.18	= 5.03		(29)
Roof	61.1	0	61.1	x 0.14	= 8.55		(30)
Total area of elements, m²			103.38				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 30.09 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.38 (36)

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

Total fabric heat loss (33) + (36) = 32.47 (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=	22.64	22.39	22.13	20.84	20.58	19.29	19.29	19.04	19.81	20.58	21.1	21.61

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

(39)m= 55.11 54.85 54.59 53.31 53.05 51.76 51.76 51.5 52.28 53.05 53.56 54.08
Average = Sum(39)_{1...12} /12= 53.24 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.55	0.55		
	Average = Sum(40) _{1...12} /12=												0.54	(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

2.72

(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

98.81

(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=	108.69	104.73	100.78	96.83	92.88	88.92	88.92	92.88	96.83	100.78	104.73	108.69		
	Total = Sum(44) _{1...12} =												1185.66	(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=	161.18	140.97	145.47	126.82	121.69	105.01	97.3	111.66	112.99	131.68	143.74	156.09		
	Total = Sum(45) _{1...12} =												1554.59	(45)

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

(46)m=	24.18	21.15	21.82	19.02	18.25	15.75	14.6	16.75	16.95	19.75	21.56	23.41		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04	(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=	188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04	
Output from water heater (annual) _{1...12}												1871.92	(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=	53.59	46.87	48.37	42.17	40.46	34.91	32.35	37.13	37.57	43.78	47.79	51.9	(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=	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	(66)

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

(67)m=	24.77	22	17.89	13.54	10.12	8.55	9.24	12	16.11	20.46	23.88	25.45	(67)

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

(68)m=	253.05	255.68	249.06	234.97	217.19	200.48	189.31	186.69	193.31	207.39	225.17	241.89	(68)

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

(69)m=	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	(71)

Water heating gains (Table 5)

(72)m=	72.03	69.75	65.01	58.57	54.38	48.49	43.49	49.9	52.18	58.85	66.38	69.76	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	413.65	411.23	395.76	370.89	345.5	321.32	305.84	312.4	325.4	350.5	379.24	400.9	(73)

6. Solar gains:

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

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	2.13	x	10.63	x	0.4	x	0.7	=	13.18 (74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	25.2 (74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	42.81 (74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	68.77 (74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	92.64 (74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	99.18	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	92.59	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	73.46	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	51.48	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	29.99	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	16.26	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	10.99	(74)
South	0.9x	0.77	x	5.97	x	46.75	x	0.4	x	0.7	=	54.16	(78)
South	0.9x	0.77	x	5.97	x	76.57	x	0.4	x	0.7	=	88.7	(78)
South	0.9x	0.77	x	5.97	x	97.53	x	0.4	x	0.7	=	112.99	(78)
South	0.9x	0.77	x	5.97	x	110.23	x	0.4	x	0.7	=	127.7	(78)
South	0.9x	0.77	x	5.97	x	114.87	x	0.4	x	0.7	=	133.07	(78)
South	0.9x	0.77	x	5.97	x	110.55	x	0.4	x	0.7	=	128.06	(78)
South	0.9x	0.77	x	5.97	x	108.01	x	0.4	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	5.97	x	104.89	x	0.4	x	0.7	=	121.51	(78)
South	0.9x	0.77	x	5.97	x	101.89	x	0.4	x	0.7	=	118.03	(78)
South	0.9x	0.77	x	5.97	x	82.59	x	0.4	x	0.7	=	95.67	(78)
South	0.9x	0.77	x	5.97	x	55.42	x	0.4	x	0.7	=	64.2	(78)
South	0.9x	0.77	x	5.97	x	40.4	x	0.4	x	0.7	=	46.8	(78)

Solar gains in watts, calculated for each month

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

(83)m=

67.34	113.89	155.8	196.47	225.71	227.24	217.72	194.97	169.5	125.66	80.46	57.79

 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=

481	525.12	551.56	567.36	571.21	548.56	523.55	507.37	494.9	476.16	459.7	458.69

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.97	0.95	0.93	0.86	0.75	0.58	0.43	0.46	0.67	0.87	0.95	0.97

 (86)

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

(87)m=

19.96	20.12	20.36	20.64	20.85	20.97	20.99	20.99	20.93	20.68	20.29	19.94

 (87)

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

(88)m=

20.72	20.72	20.72	20.73	20.73	20.74	20.74	20.74	20.73	20.73	20.73	20.72

 (88)

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

(89)m=

0.97	0.95	0.92	0.86	0.74	0.56	0.4	0.43	0.65	0.86	0.95	0.97

 (89)

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

(90)m=

19.04	19.27	19.61	20.02	20.31	20.46	20.49	20.49	20.42	20.08	19.52	19.01

 (90)

fLA = Living area ÷ (4) =

0.33

 (91)

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

(92)m=

19.34	19.55	19.85	20.22	20.48	20.63	20.65	20.65	20.59	20.28	19.77	19.31

 (92)

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

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(93)m=	19.34	19.55	19.85	20.22	20.48	20.63	20.65	20.65	20.59	20.28	19.77	19.31	(93)

8. Space heating requirement

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=	0.96	0.94	0.91	0.84	0.72	0.55	0.4	0.43	0.64	0.84	0.93	0.96	(94)

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

(95)m=	460.3	492.62	499.57	476.15	413.77	300.82	207.74	216.21	316.53	402.29	429.13	441.66	(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 , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	828.67	803.58	728.82	603.54	465.98	311.88	209.8	219.02	339.05	513.4	678.84	817.24	(97)

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

(98)m=	274.06	208.96	170.56	91.72	38.84	0	0	0	0	82.67	179.79	279.43	
Total per year ($kWh/year$) = $Sum(98)_{1..12} =$												1326.04	(98)

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

13.53	(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

Heat loss rate L_m (calculated using $25^\circ C$ internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	486.54	383.02	391.42	0	0	0	0	(100)

Utilisation factor for loss h_m

(101)m=	0	0	0	0	0	0.94	0.97	0.97	0	0	0	0	(101)

Useful loss, $h_m L_m$ (Watts) = $(100)m \times (101)m$

(102)m=	0	0	0	0	0	458.95	371.83	378.12	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	743.13	712.05	694.89	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$
set $(104)m$ to zero if $(104)m < 3 \times (98)m$

(104)m=	0	0	0	0	0	204.61	253.12	235.67	0	0	0	0	
Total = $Sum(104) =$												693.4	(104)
Cooled fraction $f_C = \text{cooled area} \div (4) =$												0.36	(105)

Intermittency factor (Table 10b)

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

Space cooling requirement for month = $(104)m \times (105) \times (106)m$

(107)m=	0	0	0	0	0	18.27	22.6	21.04	0	0	0	0	
Total = $Sum(107) =$												61.91	(107)

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

$(107) \div (4) =$	0.63	(108)

9a. Energy requirements – 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)

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Efficiency of main space heating system 1	100	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Cooling System Energy Efficiency Ratio	4.32	(209)

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

Space heating requirement (calculated above)

274.06	208.96	170.56	91.72	38.84	0	0	0	0	82.67	179.79	279.43

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

274.06	208.96	170.56	91.72	38.84	0	0	0	0	82.67	179.79	279.43

Total (kWh/year) = Sum(211)_{1..5,10...12} = 1326.04 (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..5,10...12} = 0 (215)

Water heating

Output from water heater (calculated above)

188.13	165.31	172.42	152.9	148.64	131.09	124.26	138.61	139.07	158.63	169.82	183.04

Efficiency of water heater 348.2 (216)

(217)m= 348.2 348.2 348.2 348.2 348.2 348.2 348.2 348.2 348.2 348.2 348.2 348.2 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	54.03	47.48	49.52	43.91	42.69	37.65	35.68	39.81	39.94	45.56	48.77	52.57

Total = Sum(219a)_{1..12} = 537.59 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	4.23	5.23	4.87	0	0	0	0

Total = Sum(221)_{6...8} = 14.33 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	1326.04	
Water heating fuel used	537.59	
Space cooling fuel used	14.33	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 198.02 (230a)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 198.02 (231)

Electricity for lighting 437.37 (232)

Electricity generated by PVs -876.57 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 1636.78 (338)

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	0.519	= 688.21 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)

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Water heating	(219) x	0.519	=	279.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			967.23	(265)
Space cooling	(221) x	0.519	=	7.44	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	102.77	(267)
Electricity for lighting	(232) x	0.519	=	227	(268)
Energy saving/generation technologies Item 1		0.519	=	-454.94	(269)
Total CO2, kg/year		sum of (265)...(271) =		849.49	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		8.67	(273)
El rating (section 14)				92	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-04-01

Address : B-04-01, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	71 (1a)	2.5 (2a)	177.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Walls	99.43	14.81	84.62	x 0.18	= 15.23		(29)
Roof	71	0	71	x 0.14	= 9.94		(30)
Total area of elements, m²			170.43				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 42.24 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 5.73 (36)

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

Total fabric heat loss (33) + (36) = 47.97 (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=	16.4	16.22	16.03	15.1	14.91	13.98	13.98	13.79	14.35	14.91	15.28	15.66

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

(39)m= 64.37 64.18 64 63.06 62.88 61.94 61.94 61.76 62.32 62.88 63.25 63.62
Average = Sum(39)_{1...12} /12= 63.02 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.91	0.9	0.9	0.89	0.89	0.87	0.87	0.87	0.88	0.89	0.89	0.9		
Average = Sum(40) _{1...12} /12=													0.89	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.27

(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

88.12

(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=	96.93	93.4	89.88	86.35	82.83	79.3	79.3	82.83	86.35	89.88	93.4	96.93		
Total = Sum(44) _{1...12} =													1057.39	(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=	143.74	125.72	129.73	113.1	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21		
Total = Sum(45) _{1...12} =													1386.41	(45)

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

(46)m=	21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16	(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=	170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16	
Output from water heater (annual) _{1...12}												1703.74	(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=	47.79	41.8	43.13	37.61	36.08	31.14	28.85	33.11	33.51	39.05	42.62	46.29	(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=	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	(66)

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

(67)m=	18.16	16.13	13.12	9.93	7.42	6.27	6.77	8.8	11.81	15	17.51	18.67	(67)

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

(68)m=	199.62	201.69	196.47	185.36	171.33	158.15	149.34	147.27	152.49	163.6	177.63	190.81	(68)

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

(69)m=	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)

Water heating gains (Table 5)

(72)m=	64.24	62.2	57.98	52.23	48.5	43.25	38.78	44.5	46.54	52.48	59.2	62.21	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	339.07	337.08	324.62	304.57	284.31	264.71	251.95	257.63	267.89	288.14	311.39	328.74	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62 (76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	24.35 (76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16 (76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	47.64 (76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31 (76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	78.45	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	114.42	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	140.23	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	143.55	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	136.66	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	117.39	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	91.24	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	56.53	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	30.36	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	20.03	(76)

Solar gains in watts, calculated for each month

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

(83)m=	48.97	95.8	157.77	230.09	281.99	288.66	274.82	236.07	183.49	113.67	61.06	40.27	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	388.04	432.88	482.38	534.66	566.29	553.38	526.76	493.69	451.38	401.81	372.45	369.01	(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=	0.97	0.96	0.93	0.87	0.77	0.62	0.48	0.53	0.74	0.9	0.96	0.97	(86)

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

(87)m=	19.08	19.3	19.68	20.18	20.58	20.85	20.95	20.93	20.73	20.19	19.56	19.04	(87)

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

(88)m=	20.55	20.55	20.55	20.56	20.56	20.56	20.56	20.57	20.56	20.56	20.55	20.55	(88)

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

(89)m=	0.97	0.95	0.92	0.86	0.75	0.59	0.44	0.49	0.71	0.89	0.95	0.97	(89)

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

(90)m=	17.56	17.88	18.43	19.14	19.7	20.05	20.15	20.14	19.91	19.17	18.26	17.51	(90)

fLA = Living area ÷ (4) =

0.36 (91)

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

(92)m=	18.11	18.39	18.88	19.51	20.02	20.34	20.44	20.43	20.2	19.54	18.72	18.06	(92)

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

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(93)m=	18.11	18.39	18.88	19.51	20.02	20.34	20.44	20.43	20.2	19.54	18.72	18.06	(93)

8. Space heating requirement

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=	0.95	0.94	0.9	0.83	0.72	0.57	0.43	0.47	0.69	0.86	0.94	0.96	(94)

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

(95)m=	369.83	405.02	434.5	445.01	410.36	317.29	226.49	233.26	310.71	347.43	348.3	353.73	(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 , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	888.66	865.54	792.06	669.03	522.87	355.28	237.8	248.59	380.18	562	735.22	881.83	(97)

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

(98)m=	386.01	309.47	266.02	161.29	83.71	0	0	0	0	159.64	278.58	392.91	
Total per year ($kWh/year$) = $Sum(98)_{1..12} =$												2037.63	(98)

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

28.7	(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

Heat loss rate L_m (calculated using $25^\circ C$ internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	582.26	458.38	469.35	0	0	0	0	(100)

Utilisation factor for loss h_m

(101)m=	0	0	0	0	0	0.83	0.89	0.87	0	0	0	0	(101)

Useful loss, $h_m L_m$ (Watts) = $(100)m \times (101)m$

(102)m=	0	0	0	0	0	486.01	406.68	407.29	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	728.65	696.12	658.53	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$
set (104)m to zero if $(104)m < 3 \times (98)m$

(104)m=	0	0	0	0	0	174.7	215.34	186.92	0	0	0	0	
Total = $Sum(104) =$												576.96	(104)
Cooled fraction $f_C = \text{cooled area} \div (4) =$												0.49	(105)

Intermittency factor (Table 10b)

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

Space cooling requirement for month = $(104)m \times (105) \times (106)m$

(107)m=	0	0	0	0	0	21.53	26.54	23.04	0	0	0	0	
Total = $Sum(107) =$												71.1	(107)

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

$(107) \div (4) =$	1	(108)

9a. Energy requirements – 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)

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Efficiency of main space heating system 1	100	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Cooling System Energy Efficiency Ratio	4.32	(209)

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

Space heating requirement (calculated above)

386.01	309.47	266.02	161.29	83.71	0	0	0	0	159.64	278.58	392.91

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

386.01	309.47	266.02	161.29	83.71	0	0	0	0	159.64	278.58	392.91

Total (kWh/year) = Sum(211)_{1...5,10...12} = 2037.63 (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...5,10...12} = 0 (215)

Water heating

Output from water heater (calculated above)

170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16

Efficiency of water heater 349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	48.85	42.95	44.84	39.83	38.77	34.27	32.55	36.21	36.3	41.32	44.15	47.55

Total = Sum(219a)_{1...12} = 487.61 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	4.98	6.14	5.33	0	0	0	0

Total = Sum(221)_{6...8} = 16.46 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	2037.63	
Water heating fuel used	487.61	
Space cooling fuel used	16.46	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 135.34 (230a)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 135.34 (231)

Electricity for lighting 320.72 (232)

Electricity generated by PVs -635.62 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 2362.13 (338)

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		0.519	=	1057.53 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)

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Water heating	(219) x	0.519	=	253.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1310.6	(265)
Space cooling	(221) x	0.519	=	8.54	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	70.24	(267)
Electricity for lighting	(232) x	0.519	=	166.45	(268)
Energy saving/generation technologies Item 1		0.519	=	-329.89	(269)
Total CO ₂ , kg/year		sum of (265)...(271) =		1225.95	(272)
Dwelling CO₂ Emission Rate		(272) ÷ (4) =		17.27	(273)
El rating (section 14)				86	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-04-02

Address : B-04-02, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			1.63	x1/[1/(1.2)+ 0.04]	= 1.87		(27)
Walls	54.62	12.18	42.44	x 0.18	= 7.64		(29)
Total area of elements, m²			54.62				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 21.69 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 4.69 (36)

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

Total fabric heat loss (33) + (36) = 26.38 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m= 37.94 37.8 37.67 37.02 36.88 36.23 36.23 36.1 36.49 36.88 37.15 37.41
Average = Sum(39)_{1...12} /12= 36.98 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.76	0.76	0.75	0.74	0.74	0.72	0.72	0.72	0.73	0.74	0.74	0.75		
Average = Sum(40) _{1...12} /12=													0.74	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
Total = Sum(44) _{1...12} =													892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
Total = Sum(45) _{1...12} =													1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.19	11.72	9.53	7.21	5.39	4.55	4.92	6.39	8.58	10.9	12.72	13.56	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.97	261.31	251.7	236.34	221.03	206.03	196.14	200.91	208.66	224.19	242.03	255.13	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.63	x	46.75	x	0.4	x	0.7	=	14.79	(78)
South	0.9x	0.77	x	1.63	x	76.57	x	0.4	x	0.7	=	24.22	(78)
South	0.9x	0.77	x	1.63	x	97.53	x	0.4	x	0.7	=	30.85	(78)
South	0.9x	0.77	x	1.63	x	110.23	x	0.4	x	0.7	=	34.87	(78)
South	0.9x	0.77	x	1.63	x	114.87	x	0.4	x	0.7	=	36.33	(78)

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South	0.9x	0.77	x	1.63	x	110.55	x	0.4	x	0.7	=	34.96	(78)
South	0.9x	0.77	x	1.63	x	108.01	x	0.4	x	0.7	=	34.16	(78)
South	0.9x	0.77	x	1.63	x	104.89	x	0.4	x	0.7	=	33.18	(78)
South	0.9x	0.77	x	1.63	x	101.89	x	0.4	x	0.7	=	32.22	(78)
South	0.9x	0.77	x	1.63	x	82.59	x	0.4	x	0.7	=	26.12	(78)
South	0.9x	0.77	x	1.63	x	55.42	x	0.4	x	0.7	=	17.53	(78)
South	0.9x	0.77	x	1.63	x	40.4	x	0.4	x	0.7	=	12.78	(78)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m= 47.52 88.26 136.31 188.68 224.84 227.93 217.87 190.98 154.88 102.11 58.35 39.7 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 310.5 349.56 388.02 425.02 445.86 433.97 414.01 391.89 363.55 326.3 300.37 294.83 (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=	0.95	0.93	0.89	0.8	0.67	0.51	0.38	0.41	0.62	0.84	0.93	0.96

(86)

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

(87)m= 19.61 19.83 20.16 20.55 20.81 20.95 20.99 20.98 20.89 20.54 20.02 19.57 (87)

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

(88)m=	20.62	20.62	20.62	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.63	20.63	(88)

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

(89)m=	0.95	0.93	0.88	0.79	0.65	0.48	0.35	0.38	0.6	0.82	0.93	0.96	(89)

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

(90)m=	18.4	18.72	19.2	19.74	20.09	20.27	20.31	20.31	20.2	19.74	19	18.35	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.95	19.22	19.64	20.11	20.42	20.58	20.62	20.61	20.52	20.1	19.46	18.9	(92)

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

(93)m=	18.95	19.22	19.64	20.11	20.42	20.58	20.62	20.61	20.52	20.1	19.46	18.9	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.91	0.86	0.77	0.64	0.48	0.35	0.38	0.59	0.81	0.91	0.94	(94)

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

(95)m=	290.49	317.63	333.42	326.54	284.64	206.99	143.19	148.83	213.77	262.76	272.66	278.14	(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=	555.67	541.5	494.84	414.81	321.55	216.55	145.5	152.06	234.1	350.52	459.19	550.01	(97)

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

(98)m=	197.29	150.45	120.09	63.55	27.46	0	0	0	0	65.29	134.3	202.27	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												960.71	(98)

Space heating requirement in kWh/m²/year

19.21	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	340.53	268.08	274.32	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.93	0.96	0.95	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	316.15	256.68	260.27	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	569.01	544.71	519.51	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	182.06	214.29	192.87	0	0	0	0	
Total = Sum(104) =												589.22	(104)

Cooled fraction

f C = cooled area ÷ (4) =	0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = Sum(104) =	0	(106)

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

(107)m=	0	0	0	0	0	31.86	37.5	33.75	0	0	0	0		
Total = Sum(107) =													103.11	(107)
Space cooling requirement in kWh/m ² /year													2.06	(108)
(107) ÷ (4) =														

9a. Energy requirements – 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		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.32	(209)

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

Space heating requirement (calculated above)

	197.29	150.45	120.09	63.55	27.46	0	0	0	0	65.29	134.3	202.27		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	197.29	150.45	120.09	63.55	27.46	0	0	0	0	65.29	134.3	202.27		
Total (kWh/year) = Sum(211) _{1..5,10...12} =													960.71	(211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)														
(215)m=	0	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)

	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39		
Efficiency of water heater													349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32		
Total = Sum(219a) _{1..12} =													425.57	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	7.38	8.68	7.81	0	0	0	0		
Total = Sum(221) _{6..8} =													23.87	(221)

Annual totals

		kWh/year	kWh/year
Space heating fuel used, main system 1			960.71
Water heating fuel used			425.57
Space cooling fuel used			23.87
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		95.31
			(231)

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Electricity for lighting	232.95	(232)
Electricity generated by PVs	-447.36	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1291.05	(338)

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		0.519	=	498.61	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =				719.48	(265)
Space cooling	(221) x		0.519	=	12.39	(266)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	49.47	(267)
Electricity for lighting	(232) x		0.519	=	120.9	(268)
Energy saving/generation technologies Item 1			0.519	=	-232.18	(269)
Total CO2, kg/year		sum of (265)...(271) =			670.06	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			13.4	(273)
El rating (section 14)					91	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-04-03

Address : B-04-03, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	37.97	10.55	27.42	x 0.18	= 4.94		(29)
Total area of elements, m²			37.97				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 17.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.99 (36)

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

Total fabric heat loss (33) + (36) = 21.12 (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=	10.96	10.84	10.72	10.12	10	9.4	9.4	9.28	9.64	10	10.24	10.48

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

(39)m= 32.08 31.96 31.84 31.24 31.12 30.52 30.52 30.4 30.76 31.12 31.36 31.6
Average = Sum(39)_{1...12} /12= 31.21 (39)

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

(40)m= 0.64 0.64 0.64 0.62 0.62 0.61 0.61 0.61 0.62 0.62 0.63 0.63
Average = Sum(40)_{1...12} /12= 0.62 (40)

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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

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

1.69

(42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

74.34

(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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	
Total = Sum(44) _{1...12} =												892.08	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Total = Sum(45) _{1...12} =												1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62	(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

 (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	0

 (63)

Output from water heater

(64)m=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Output from water heater (annual)_{1...12}

1486.99

 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=

40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51

 (66)

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

(67)m=

13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89

 (67)

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

(68)m=

147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74

 (68)

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

(69)m=

31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

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

(71)m=

-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6

 (71)

Water heating gains (Table 5)

(72)m=

54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>24.62</td></tr></table> (80)	24.62
0.77																		
6.46																		
19.64																		
0.4																		
0.7																		
24.62																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>8.12</td></tr></table> (80)	8.12
0.77																		
2.13																		
19.64																		
0.4																		
0.7																		
8.12																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>48.16</td></tr></table> (80)	48.16
0.77																		
6.46																		
38.42																		
0.4																		
0.7																		
48.16																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>15.88</td></tr></table> (80)	15.88
0.77																		
2.13																		
38.42																		
0.4																		
0.7																		
15.88																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>79.31</td></tr></table> (80)	79.31
0.77																		
6.46																		
63.27																		
0.4																		
0.7																		
79.31																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>26.15</td></tr></table> (80)	26.15
0.77																		
2.13																		
63.27																		
0.4																		
0.7																		
26.15																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>115.67</td></tr></table> (80)	115.67
0.77																		
6.46																		
92.28																		
0.4																		
0.7																		
115.67																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>38.14</td></tr></table> (80)	38.14
0.77																		
2.13																		
92.28																		
0.4																		
0.7																		
38.14																		

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m=	32.74	64.04	105.46	153.81	188.5	192.97	183.71	157.81	122.66	75.99	40.82	26.92	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	296.03	325.63	357.4	390.33	409.66	399.11	379.97	358.87	331.53	300.45	283.15	282.38	(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=	0.95	0.93	0.88	0.79	0.64	0.48	0.35	0.38	0.6	0.83	0.93	0.96	(86)

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

(87)m=	19.9	20.08	20.37	20.69	20.89	20.97	20.99	20.99	20.94	20.67	20.24	19.87	(87)

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

(88)m=	20.68	20.68	20.68	20.69	20.69	20.69	20.69	20.7	20.69	20.69	20.69	20.68	(88)

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

(89)m=	0.95	0.93	0.88	0.77	0.63	0.45	0.33	0.36	0.58	0.82	0.92	0.96	(89)

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

(90)m=	18.9	19.16	19.56	20.02	20.28	20.4	20.42	20.42	20.35	20	19.4	18.85	(90)

fLA = Living area ÷ (4) =

0.45

(91)

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

(92)m=	19.35	19.58	19.93	20.32	20.56	20.66	20.68	20.68	20.62	20.31	19.78	19.31	(92)

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

(93)m=	19.35	19.58	19.93	20.32	20.56	20.66	20.68	20.68	20.62	20.31	19.78	19.31	(93)

8. 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=	0.94	0.91	0.86	0.76	0.62	0.45	0.33	0.36	0.57	0.8	0.91	0.94	(94)

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

(95)m=	277.2	296.8	307.64	297.12	253.9	180.36	123.55	128.66	189.01	240.71	257	266.57	(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=	482.81	469.06	427.52	356.8	275.56	184.91	124.48	130.03	200.47	302.09	397.75	477.6	(97)

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

(98)m=	152.98	115.76	89.19	42.97	16.11	0	0	0	0	45.66	101.34	157.01	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

721.02 (98)

Space heating requirement in kWh/m²/year

14.42 (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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	286.88	225.84	231.04	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.96	0.98	0.97	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	275.18	220.9	224.7	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	528.42	505.08	481.12	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	182.33	211.43	190.77	0	0	0	0	(104)

Total = Sum(104) = 584.53 (104)

Cooled fraction

f C = cooled area ÷ (4) = 0.7 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	(106)

Total = Sum(104) = 0 (106)

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

(107)m=	0	0	0	0	0	31.91	37	33.39	0	0	0	0	(107)

Total = Sum(107) = 102.29 (107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) = 2.05 (108)

9a. Energy requirements – 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

100 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Cooling System Energy Efficiency Ratio

4.32 (209)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	152.98	115.76	89.19	42.97	16.11	0	0	0	0	45.66	101.34	157.01	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$													(211)
	152.98	115.76	89.19	42.97	16.11	0	0	0	0	45.66	101.34	157.01	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													721.02 (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	0	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Efficiency of water heater													349.41 (216)
(217)m =	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m $\times 100 \div (217)m$													
(219)m =	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32	
Total = Sum(219a) _{1..12} =													425.57 (219)
Space cooling fuel, kWh/month.													
(221)m = (107)m $\div (209)$													
(221)m =	0	0	0	0	0	7.39	8.56	7.73	0	0	0	0	
Total = Sum(221) _{6..8} =													23.68 (221)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													721.02
Water heating fuel used													425.57
Space cooling fuel used													23.68
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													95.31 (230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												95.31 (231)
Electricity for lighting													238.63 (232)
Electricity generated by PVs													-447.36 (233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													1056.86 (338)

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	0.519	374.21 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	220.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		595.08 (265)

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Space cooling	(221) x	0.519	=	12.29	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Energy saving/generation technologies Item 1		0.519	=	-232.18	(269)
Total CO2, kg/year	sum of (265)...(271) =			548.51	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			10.97	(273)
El rating (section 14)				92	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson **Stroma Number:** STRO006273
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: B-04-04

Address : B-04-04, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50 (1a)	2.5 (2a)	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	40.33	16.94	23.39	x 0.18	= 4.21		(29)
Roof	50	0	50	x 0.14	= 7		(30)
Total area of elements, m²			90.33				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 30.71 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 5.3 (36)

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

Total fabric heat loss (33) + (36) = 36.01 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

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

(39)m=	47.57	47.44	47.3	46.65	46.51	45.86	45.86	45.73	46.12	46.51	46.78	47.04
Average = Sum(39) _{1...12} /12=												46.61 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.95	0.95	0.95	0.93	0.93	0.92	0.92	0.91	0.92	0.93	0.94	0.94		
	Average = Sum(40) _{1...12} /12=												0.93	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
	Total = Sum(44) _{1...12} =												892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
	Total = Sum(45) _{1...12} =												1169.66	(45)

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

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.13	11.66	9.48	7.18	5.37	4.53	4.89	6.36	8.54	10.84	12.66	13.49	(67)

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

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

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

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	262.91	261.25	251.66	236.31	221	206.01	196.11	200.88	208.62	224.14	241.96	255.07	(73)

6. Solar gains:

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

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	2.13	x	10.63	x	0.4	x	0.7	=	13.18	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	25.2	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	42.81	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	68.77	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	92.64	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	99.18	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	92.59	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	73.46	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	51.48	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	29.99	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	16.26	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	10.99	(74)
West	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(80)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

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

(83)m= 45.92 89.24 148.28 222.58 281.14 292.14 276.3 231.27 174.14 105.98 57.08 37.91 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 308.83 350.49 399.94 458.89 502.15 498.15 472.42 432.15 382.76 330.12 299.05 292.98 (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=	0.96	0.94	0.9	0.82	0.69	0.53	0.41	0.46	0.68	0.87	0.94	0.97

(86)

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

(87)m= 19.09 19.34 19.75 20.27 20.67 20.89 20.96 20.95 20.77 20.24 19.58 19.05 (87)

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

(88)m=	20.52	20.53	20.53	20.53	20.53	20.54	20.54	20.54	20.54	20.53	20.53	20.53	(88)

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

(89)m=	0.96	0.94	0.9	0.81	0.67	0.5	0.37	0.42	0.65	0.86	0.94	0.96	(89)

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

(90)m=	17.55	17.91	18.5	19.24	19.77	20.05	20.13	20.12	19.92	19.21	18.27	17.49	(90)

fLA = Living area ÷ (4) =	0.58	(91)

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

(92)m=	18.44	18.73	19.23	19.84	20.29	20.54	20.61	20.6	20.41	19.81	19.03	18.39	(92)

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

(93)m=	18.44	18.73	19.23	19.84	20.29	20.54	20.61	20.6	20.41	19.81	19.03	18.39	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.92	0.88	0.79	0.66	0.5	0.38	0.42	0.64	0.84	0.92	0.95	(94)

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

(95)m=	291.16	322.5	349.98	361.28	330.67	250.44	177.29	182.46	245.15	276.35	275.43	278.15	(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=	672.69	656.18	602	510.23	399.55	272.3	183.96	191.99	291.07	428.25	557.94	667.55	(97)

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

(98)m=	283.86	224.24	187.5	107.25	51.25	0	0	0	0	113.01	203.41	289.72	(98)

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1460.22	(98)

Space heating requirement in kWh/m²/year

29.2	(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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	431.06	339.34	347.52	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.88	0.92	0.9	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	378.09	311.33	311.9	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	644	612.94	566.51	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

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

(104)m=	0	0	0	0	0	191.45	224.4	189.43	0	0	0	0	(104)

Total = Sum(104) =	605.29	(104)

Cooled fraction

f C = cooled area ÷ (4) =	0.7	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	(106)

Total = Sum(104) =	0	(106)

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

(107)m=	0	0	0	0	0	33.5	39.27	33.15	0	0	0	0		
													Total = Sum(107) =	105.93 (107)
Space cooling requirement in kWh/m ² /year													(107) ÷ (4) =	2.12 (108)

9a. Energy requirements – 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		100 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)
Cooling System Energy Efficiency Ratio		4.32 (209)

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

Space heating requirement (calculated above)

	283.86	224.24	187.5	107.25	51.25	0	0	0	0	113.01	203.41	289.72		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	283.86	224.24	187.5	107.25	51.25	0	0	0	0	113.01	203.41	289.72		
													Total (kWh/year) = Sum(211) _{1..5,10...12} =	1460.22 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)														
(215)m=	0	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)

	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39		
Efficiency of water heater													349.41 (216)	
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32		
													Total = Sum(219a) _{1..12} =	425.57 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	7.76	9.09	7.67	0	0	0	0		
													Total = Sum(221) _{6..8} =	24.52 (221)

Annual totals

		kWh/year	kWh/year
Space heating fuel used, main system 1			1460.22
Water heating fuel used			425.57
Space cooling fuel used			24.52
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		95.31 (231)

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Electricity for lighting	231.81	(232)
Electricity generated by PVs	-447.36	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1790.08	(338)

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	0.519	=	757.85	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			978.73	(265)
Space cooling	(221) x	0.519	=	12.73	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	120.31	(268)
Energy saving/generation technologies Item 1		0.519	=	-232.18	(269)
Total CO2, kg/year		sum of (265)...(271) =		929.05	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.58	(273)
El rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: B-04-05

Address : B-04-05, Block B, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	62	(1a) x	2.5	(2a) =	155 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			155 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Walls	73.4	12.61	60.79	x 0.18	= 10.94		(29)
Roof	62	0	62	x 0.14	= 8.68		(30)
Total area of elements, m²			135.4				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 34.17 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.38 (36)

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

Total fabric heat loss (33) + (36) = 36.55 (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=	14.33	14.16	14	13.18	13.02	12.21	12.21	12.04	12.53	13.02	13.35	13.67

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

(39)m= 50.87 50.71 50.54 49.73 49.57 48.75 48.75 48.59 49.08 49.57 49.89 50.22
Average = Sum(39)_{1...12} /12= 49.69 (39)

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Heat loss parameter (HLP), W/m²K

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

(40)m=	0.82	0.82	0.82	0.8	0.8	0.79	0.79	0.78	0.79	0.8	0.8	0.81		
Average = Sum(40) _{1...12} /12=													0.8	(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

2.04

(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

82.59

(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=	90.85	87.55	84.24	80.94	77.64	74.33	74.33	77.64	80.94	84.24	87.55	90.85		
Total = Sum(44) _{1...12} =													991.11	(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=	134.73	117.84	121.6	106.01	101.72	87.78	81.34	93.34	94.45	110.07	120.15	130.48		
Total = Sum(45) _{1...12} =													1299.5	(45)

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

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.02	19.57		(46)

Water storage loss:

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

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	161.68	142.18	148.55	132.09	128.67	113.86	108.29	120.29	120.53	137.02	146.24	157.43	(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=	161.68	142.18	148.55	132.09	128.67	113.86	108.29	120.29	120.53	137.02	146.24	157.43	
Output from water heater (annual) _{1...12}												1616.83	(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=	44.8	39.18	40.43	35.25	33.82	29.19	27.04	31.03	31.4	36.6	39.95	43.38	(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=	101.88	101.88	101.88	101.88	101.88	101.88	101.88	101.88	101.88	101.88	101.88	101.88	(66)

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

(67)m=	16.33	14.51	11.8	8.93	6.68	5.64	6.09	7.92	10.63	13.49	15.75	16.79	(67)

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

(68)m=	177.96	179.81	175.15	165.25	152.74	140.99	133.14	131.29	135.94	145.85	158.36	170.11	(68)

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

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	(71)

Water heating gains (Table 5)

(72)m=	60.21	58.3	54.34	48.96	45.46	40.54	36.35	41.71	43.62	49.19	55.49	58.31	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	308.07	306.18	294.86	276.7	258.44	240.72	229.14	234.48	243.75	262.1	283.15	298.77	(73)

6. Solar gains:

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

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	2.13	x	10.63	x	0.4	x	0.7	=	13.18	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	25.2	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	42.81	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	68.77	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	92.64	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	99.18	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	92.59	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	73.46	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	51.48	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	29.99	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	16.26	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	10.99	(74)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(76)

Solar gains in watts, calculated for each month

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

(83)m=	29.42	56.96	95.12	145.05	186.12	194.87	183.7	151.72	112.31	67.68	36.51	24.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	337.49	363.14	389.97	421.75	444.57	435.6	412.84	386.2	356.06	329.78	319.66	323.11	(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=	0.97	0.96	0.94	0.88	0.78	0.63	0.49	0.54	0.75	0.9	0.96	0.97	(86)

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

(87)m=	19.3	19.48	19.8	20.25	20.63	20.88	20.96	20.95	20.76	20.29	19.73	19.27	(87)

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

(88)m=	20.59	20.59	20.59	20.6	20.6	20.61	20.61	20.61	20.6	20.6	20.6	20.6	(88)

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

(89)m=	0.97	0.96	0.93	0.87	0.77	0.6	0.45	0.5	0.73	0.9	0.95	0.97	(89)

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

(90)m=	17.93	18.18	18.65	19.29	19.82	20.14	20.23	20.22	20.01	19.36	18.56	17.89	(90)

fLA = Living area ÷ (4) =

0.44 (91)

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

(92)m=	18.53	18.75	19.16	19.71	20.18	20.47	20.55	20.54	20.34	19.77	19.08	18.5	(92)

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

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(93)m=	18.53	18.75	19.16	19.71	20.18	20.47	20.55	20.54	20.34	19.77	19.08	18.5	(93)

8. Space heating requirement

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=	0.95	0.94	0.91	0.85	0.75	0.59	0.45	0.49	0.71	0.87	0.94	0.96	(94)

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

(95)m=	321.88	341.47	355.69	359.01	331.69	257.46	184.49	189.82	252.34	288.1	299.44	309.79	(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 , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	723.96	702.35	639.77	537.76	420.08	285.94	192.77	201.25	306.35	454.44	597.49	718.01	(97)

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

(98)m=	299.14	242.51	211.36	128.7	65.76	0	0	0	0	123.76	214.6	303.71	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1589.54	(98)

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

25.64	(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

Heat loss rate L_m (calculated using $25^\circ C$ internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	458.26	360.76	369.27	0	0	0	0	(100)

Utilisation factor for loss h_m

(101)m=	0	0	0	0	0	0.85	0.9	0.88	0	0	0	0	(101)

Useful loss, $h_m L_m$ (Watts) = $(100)m \times (101)m$

(102)m=	0	0	0	0	0	390.92	325.62	326.48	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	582.84	555.02	524.81	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$
set $(104)m$ to zero if $(104)m < 3 \times (98)m$

(104)m=	0	0	0	0	0	138.19	170.67	147.56	0	0	0	0	
Total = $Sum(104) =$												456.41	(104)
Cooled fraction $f_C = \text{cooled area} \div (4) =$												0.56	(105)

Intermittency factor (Table 10b)

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

Space cooling requirement for month = $(104)m \times (105) \times (106)m$

(107)m=	0	0	0	0	0	19.5	24.09	20.82	0	0	0	0	
Total = $Sum(107) =$												64.41	(107)

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

$(107) \div (4) =$	1.04	(108)

9a. Energy requirements – 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)

DER WorkSheet: New dwelling design stage

Efficiency of main space heating system 1	100	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Cooling System Energy Efficiency Ratio	4.32	(209)

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

Space heating requirement (calculated above)

299.14	242.51	211.36	128.7	65.76	0	0	0	0	123.76	214.6	303.71

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

299.14	242.51	211.36	128.7	65.76	0	0	0	0	123.76	214.6	303.71

Total (kWh/year) = Sum(211)_{1..5,10...12} = 1589.54 (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	0

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

Water heating

Output from water heater (calculated above)

161.68	142.18	148.55	132.09	128.67	113.86	108.29	120.29	120.53	137.02	146.24	157.43

Efficiency of water heater	349.41	(216)

(217)m=

349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

46.27	40.69	42.51	37.8	36.83	32.59	30.99	34.43	34.5	39.22	41.85	45.06

Total = Sum(219a)_{1..12} = 462.73 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=

0	0	0	0	0	4.51	5.58	4.82	0	0	0	0

Total = Sum(221)_{6...8} = 14.91 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	1589.54	
Water heating fuel used	462.73	
Space cooling fuel used	14.91	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside	125.28	(230a)

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	125.28	(231)

Electricity for lighting	288.44	(232)

Electricity generated by PVs	-554.44	(233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1926.45	(338)

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	0.519	= 824.97 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)

DER WorkSheet: New dwelling design stage

Water heating	(219) x	0.519	=	240.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1065.13	(265)
Space cooling	(221) x	0.519	=	7.74	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	65.02	(267)
Electricity for lighting	(232) x	0.519	=	149.7	(268)
Energy saving/generation technologies Item 1		0.519	=	-287.76	(269)
Total CO2, kg/year	sum of (265)...(271) =			999.83	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			16.13	(273)
El rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-00-01

Address : C-00-01, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	77	(1a) x	2.5	(2a) =	192.5
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			192.5

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	+	0
Number of open flues	0	+	0	+	0
Number of intermittent fans				0	0
Number of passive vents				0	0
Number of flueless gas fires				0	0

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0
<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
Additional infiltration		[(9)-1]x0.1 =	0
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0
<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
If no draught lobby, enter 0.05, else enter 0			0
Percentage of windows and doors draught stripped			0
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15
<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
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.13

Infiltration rate modified for monthly wind speed

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

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

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

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

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$x1/[1/(1.2)+0.04] =$	7.4		(27)
Windows Type 2			2.13	$x1/[1/(1.2)+0.04] =$	2.44		(27)
Windows Type 3			2.13	$x1/[1/(1.2)+0.04] =$	2.44		(27)
Floor			77	x 0.12 =	9.24		(28)
Walls	97.38	10.72	86.65	x 0.18 =	15.6		(29)
Roof	3.17	0	3.17	x 0.14 =	0.44		(30)
Total area of elements, m²			177.55				(31)

* 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) = 37.56 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 4.33 (36)

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

Total fabric heat loss (33) + (36) = 41.88 (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=	17.79	17.59	17.39	16.37	16.17	15.16	15.16	14.96	15.56	16.17	16.58	16.98

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.67	59.47	59.27	58.26	58.05	57.04	57.04	56.84	57.45	58.05	58.46	58.86
Average = Sum(39) _{1...12} /12=												58.21 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.77	0.77	0.77	0.76	0.75	0.74	0.74	0.74	0.75	0.75	0.76	0.76		
	Average = Sum(40) _{1...12} /12=												0.76	(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

2.4

(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

91.28

(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=	100.41	96.76	93.11	89.46	85.81	82.15	82.15	85.81	89.46	93.11	96.76	100.41		
	Total = Sum(44) _{1...12} =												1095.39	(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=	148.91	130.23	134.39	117.16	112.42	97.01	89.9	103.16	104.39	121.65	132.8	144.21		
	Total = Sum(45) _{1...12} =												1436.23	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.34	19.54	20.16	17.57	16.86	14.55	13.48	15.47	15.66	18.25	19.92	21.63		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	175.86	154.58	161.34	143.25	139.37	123.09	116.85	130.11	130.47	148.61	158.88	171.16	(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=	175.86	154.58	161.34	143.25	139.37	123.09	116.85	130.11	130.47	148.61	158.88	171.16	
Output from water heater (annual) _{1...12}												1753.56	(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=	49.51	43.3	44.68	38.96	37.38	32.26	29.89	34.3	34.71	40.45	44.15	47.95	(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=	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.4	18.12	14.74	11.16	8.34	7.04	7.61	9.89	13.27	16.85	19.67	20.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	213.06	215.27	209.7	197.84	182.86	168.79	159.39	157.18	162.75	174.61	189.58	203.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	(71)

Water heating gains (Table 5)

(72)m=	66.55	64.44	60.06	54.11	50.24	44.8	40.18	46.1	48.21	54.37	61.33	64.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	359.06	356.88	343.55	322.15	300.5	279.69	266.23	272.22	283.28	304.89	329.63	348.12	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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	2.13	x	10.63	x	0.4	x	0.7	=	4.39	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	8.4	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	14.27	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	30.88	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	33.06	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	30.86	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	24.49	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	17.16	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	10	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	5.42	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	3.66	(74)
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 37.13 72.44 119.74 176.74 219.38 226.03 214.58 182.29 139.82 85.99 46.24 30.58 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 396.19 429.32 463.28 498.89 519.88 505.71 480.8 454.52 423.1 390.87 375.87 378.71 (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=	0.97	0.96	0.94	0.89	0.79	0.64	0.49	0.54	0.75	0.91	0.96	0.98

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.37 19.55 19.87 20.3 20.65 20.89 20.96 20.95 20.79 20.33 19.79 19.34 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.61	20.61	20.62	20.62	20.62	20.63	20.63	20.63	20.63	20.62	20.62	20.62	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.94	0.88	0.77	0.61	0.46	0.5	0.73	0.9	0.96	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.05	18.31	18.77	19.39	19.88	20.19	20.28	20.27	20.07	19.45	18.67	18.02	(90)

fLA = Living area ÷ (4) =	0.37	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.54	18.77	19.18	19.73	20.17	20.45	20.53	20.52	20.34	19.78	19.09	18.51	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.54	18.77	19.18	19.73	20.17	20.45	20.53	20.52	20.34	19.78	19.09	18.51	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.92	0.86	0.75	0.6	0.45	0.49	0.71	0.88	0.94	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	379.7	405.59	424.47	427.15	391.74	302.38	215.8	222.7	299.81	343.2	354.04	364.79	(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=	849.96	824.92	751.55	630.75	491.72	333.7	224.4	234.41	358.43	532.85	700.71	842.39	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	349.88	281.79	243.35	146.59	74.38	0	0	0	0	141.1	249.6	355.33	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1842.02	(98)

Space heating requirement in kWh/m²/year

23.92	(99)

9a. Energy requirements – 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

100	(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)

349.88	281.79	243.35	146.59	74.38	0	0	0	0	141.1	249.6	355.33

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

349.88	281.79	243.35	146.59	74.38	0	0	0	0	141.1	249.6	355.33

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1842.02 \quad (211)$$

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	0	

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

175.86	154.58	161.34	143.25	139.37	123.09	116.85	130.11	130.47	148.61	158.88	171.16

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

50.33	44.24	46.18	41	39.89	35.23	33.44	37.24	37.34	42.53	45.47	48.99

Total = Sum(219a)_{1..12} =

501.86 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1842.02

Water heating fuel used

501.86

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

146.78

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

146.78

(231)

Electricity for lighting

360.31

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2850.97

(238)

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		0.519	=	956.01	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.519	=	260.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1216.48	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	76.18	(267)
Electricity for lighting	(232) x		0.519	=	187	(268)
Total CO2, kg/year				sum of (265)...(271) =	1479.66	(272)
Dwelling CO2 Emission Rate				(272) ÷ (4) =	19.22	(273)
EI rating (section 14)					84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-00-02

Address : C-00-02, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	56	(1a) x	2.5	(2a) =	140 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			140 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$\times 1/[1/(1.2) + 0.04] =$	7.4		(27)
Windows Type 2			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Windows Type 3			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Floor			56	$\times$ 0.12	6.72		(28)
Walls	55.42	10.72	44.7	$\times$ 0.18	8.05		(29)
Total area of elements, m²			111.42				(31)

* 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) = 27.04 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 4.41 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.46 (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=	12.94	12.79	12.64	11.91	11.76	11.02	11.02	10.88	11.32	11.76	12.06	12.35

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 44.4 44.25 44.1 43.36 43.22 42.48 42.48 42.33 42.78 43.22 43.51 43.81
Average = Sum(39)_{1...12} /12= 43.33 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.79	0.79	0.79	0.77	0.77	0.76	0.76	0.76	0.76	0.77	0.78	0.78		
	Average = Sum(40) _{1...12} /12=												0.77	(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

1.87

(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

78.53

(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=	86.38	83.24	80.1	76.96	73.82	70.68	70.68	73.82	76.96	80.1	83.24	86.38		
	Total = Sum(44) _{1...12} =												942.38	(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=	128.11	112.04	115.62	100.8	96.72	83.46	77.34	88.75	89.81	104.66	114.25	124.06		
	Total = Sum(45) _{1...12} =												1235.61	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.22	16.81	17.34	15.12	14.51	12.52	11.6	13.31	13.47	15.7	17.14	18.61		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	(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=	155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02	
Output from water heater (annual) _{1...12}												1552.94	(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=	42.6	37.25	38.44	33.52	32.16	27.75	25.72	29.51	29.86	34.8	37.99	41.25	(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=	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	93.33	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.69	13.05	10.61	8.03	6	5.07	5.48	7.12	9.56	12.13	14.16	15.1	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	162.76	164.45	160.19	151.13	139.69	128.94	121.76	120.07	124.33	133.39	144.83	155.58	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	32.33	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	-74.66	(71)

Water heating gains (Table 5)

(72)m=	57.25	55.44	51.67	46.55	43.22	38.54	34.56	39.66	41.47	46.77	52.76	55.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.7	283.93	273.47	256.71	239.92	223.55	212.8	217.85	226.36	243.3	262.75	277.12	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12 (76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88 (76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15 (76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14 (76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74 (76)

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East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
South	0.9x	0.77	x	6.46	x	46.75	x	0.4	x	0.7	=	58.6	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	6.46	x	76.57	x	0.4	x	0.7	=	95.98	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	6.46	x	97.53	x	0.4	x	0.7	=	122.26	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	6.46	x	110.23	x	0.4	x	0.7	=	138.18	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	6.46	x	114.87	x	0.4	x	0.7	=	143.99	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	6.46	x	110.55	x	0.4	x	0.7	=	138.57	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	6.46	x	108.01	x	0.4	x	0.7	=	135.39	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	6.46	x	104.89	x	0.4	x	0.7	=	131.49	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	6.46	x	101.89	x	0.4	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	6.46	x	82.59	x	0.4	x	0.7	=	103.52	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	6.46	x	55.42	x	0.4	x	0.7	=	69.47	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	6.46	x	40.4	x	0.4	x	0.7	=	50.64	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 86.04 143.5 188.72 221.88 238.21 232.11 225.59 213.97 200.24 156.5 102.49 74.01 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 371.74 427.43 462.19 478.59 478.13 455.66 438.39 431.82 426.6 399.79 365.24 351.13 (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=	0.95	0.92	0.88	0.81	0.7	0.55	0.41	0.43	0.62	0.82	0.92	0.95

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.58 19.83 20.15 20.49 20.76 20.92 20.98 20.97 20.88 20.55 20.01 19.54 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.6	20.6	20.61	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.61	20.61	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.91	0.87	0.79	0.68	0.52	0.38	0.4	0.59	0.8	0.91	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.35	18.71	19.15	19.64	20	20.22	20.27	20.27	20.16	19.73	18.98	18.28	(90)

fLA = Living area ÷ (4) =	0.61	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.39	19.75	20.16	20.46	20.64	20.7	20.7	20.6	20.22	19.61	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.39	19.75	20.16	20.46	20.64	20.7	20.7	20.6	20.22	19.61	19.04	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.93	0.9	0.85	0.78	0.68	0.53	0.39	0.41	0.59	0.79	0.9	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	345.35	383.09	393.38	373.21	322.98	239.88	169.72	176.45	251.69	314.92	327.49	329.36	(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=	656.83	641.15	584.44	488.09	378.44	256.77	174.18	181.9	277.99	415.89	544.12	650.15	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	231.75	173.42	142.15	82.71	41.26	0	0	0	0	75.12	155.97	238.67	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1141.05	(98)

Space heating requirement in kWh/m²/year

20.38	(99)

9a. Energy requirements – 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

100	(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)

231.75	173.42	142.15	82.71	41.26	0	0	0	0	75.12	155.97	238.67

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

231.75	173.42	142.15	82.71	41.26	0	0	0	0	75.12	155.97	238.67

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1141.05 \quad (211)$$

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...5,10...12} =												0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

155.06	136.39	142.57	126.88	123.67	109.54	104.29	115.7	115.89	131.61	140.33	151.02

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

44.38	39.03	40.8	36.31	35.39	31.35	29.85	33.11	33.17	37.67	40.16	43.22

Total = Sum(219a)_{1..12} =

444.45 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1141.05

Water heating fuel used

444.45

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

106.75

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

106.75

(231)

Electricity for lighting

259.39

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

1951.63

(238)

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	0.519	=	592.2	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	230.67	(264)
Space and water heating	(261) + (262) + (263) + (264) =			822.87	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	55.4	(267)
Electricity for lighting	(232) x	0.519	=	134.62	(268)
Total CO2, kg/year			sum of (265)...(271) =	1012.9	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	18.09	(273)
EI rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-00-03

Address : C-00-03, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50 (1a)	2.5 (2a)	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$\times 1/[1/(1.2) + 0.04] =$	7.4		(27)
Windows Type 2			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Floor			50	$\times$ 0.12	6		(28)
Walls	51.75	8.59	43.16	$\times$ 0.18	7.77		(29)
Total area of elements, m²			101.75				(31)

* 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) = 23.6 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 4.02 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.63 (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=	10.96	10.84	10.72	10.12	10	9.4	9.4	9.28	9.64	10	10.24	10.48

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 38.59 38.47 38.35 37.75 37.63 37.03 37.03 36.91 37.27 37.63 37.87 38.11
Average = Sum(39)_{1...12} /12= 37.72 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 0.77 0.77 0.77 0.76 0.75 0.74 0.74 0.74 0.75 0.75 0.76 0.76
Average = Sum(40)_{1...12} /12= 0.75 (40)

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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

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

1.69

(42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

74.34

(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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	
Total = Sum(44) _{1...12} =												892.08	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Total = Sum(45) _{1...12} =												1169.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

 (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	0

 (63)

Output from water heater

(64)m=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Output from water heater (annual)_{1...12}

1486.99

 (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=

40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6

 (71)

Water heating gains (Table 5)

(72)m=

54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>58.6</td></tr></table>	58.6	(78)
0.77																			
6.46																			
46.75																			
0.4																			
0.7																			
58.6																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>19.32</td></tr></table>	19.32	(78)
0.77																			
2.13																			
46.75																			
0.4																			
0.7																			
19.32																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>95.98</td></tr></table>	95.98	(78)
0.77																			
6.46																			
76.57																			
0.4																			
0.7																			
95.98																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>31.65</td></tr></table>	31.65	(78)
0.77																			
2.13																			
76.57																			
0.4																			
0.7																			
31.65																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>122.26</td></tr></table>	122.26	(78)
0.77																			
6.46																			
97.53																			
0.4																			
0.7																			
122.26																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>40.31</td></tr></table>	40.31	(78)
0.77																			
2.13																			
97.53																			
0.4																			
0.7																			
40.31																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>138.18</td></tr></table>	138.18	(78)
0.77																			
6.46																			
110.23																			
0.4																			
0.7																			
138.18																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>45.56</td></tr></table>	45.56	(78)
0.77																			
2.13																			
110.23																			
0.4																			
0.7																			
45.56																			

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	6.46	x	114.87	x	0.4	x	0.7	=	143.99	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	6.46	x	110.55	x	0.4	x	0.7	=	138.57	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	6.46	x	108.01	x	0.4	x	0.7	=	135.39	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	6.46	x	104.89	x	0.4	x	0.7	=	131.49	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	6.46	x	101.89	x	0.4	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	6.46	x	82.59	x	0.4	x	0.7	=	103.52	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	6.46	x	55.42	x	0.4	x	0.7	=	69.47	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	6.46	x	40.4	x	0.4	x	0.7	=	50.64	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	77.93	127.62	162.57	183.74	191.47	184.26	180.03	174.84	169.82	137.65	92.37	67.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	341.22	389.22	414.51	420.26	412.63	390.41	376.29	375.9	378.7	362.11	334.71	322.8	(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=	0.94	0.91	0.87	0.81	0.71	0.56	0.42	0.44	0.61	0.8	0.91	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.67	19.91	20.2	20.51	20.76	20.92	20.98	20.98	20.89	20.59	20.08	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.61	20.62	20.62	20.62	20.62	20.63	20.63	20.63	20.63	20.62	20.62	20.62	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.91	0.86	0.8	0.69	0.53	0.39	0.4	0.59	0.79	0.91	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.49	18.83	19.24	19.68	20.02	20.23	20.29	20.29	20.19	19.79	19.09	18.42	(90)

fLA = Living area ÷ (4) =

0.56 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.15	19.44	19.78	20.15	20.44	20.62	20.68	20.67	20.58	20.24	19.65	19.1	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.15	19.44	19.78	20.15	20.44	20.62	20.68	20.67	20.58	20.24	19.65	19.1	(93)

8. 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=	0.92	0.89	0.85	0.78	0.68	0.53	0.39	0.41	0.58	0.78	0.89	0.93	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	314.84	346.07	350.51	327.57	280.97	208.33	147.22	153.33	220.59	281.16	297.23	300.92	(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=	573.18	559.3	509.16	424.67	328.74	222.97	150.98	157.78	241.7	362.7	475.24	567.75	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	192.2	143.3	118.03	69.91	35.54	0	0	0	0	60.67	128.16	198.52	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												946.34	(98)

Space heating requirement in kWh/m²/year

18.93	(99)

9a. Energy requirements – 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 1 100 (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)

192.2	143.3	118.03	69.91	35.54	0	0	0	0	60.67	128.16	198.52

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

192.2	143.3	118.03	69.91	35.54	0	0	0	0	60.67	128.16	198.52		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												946.34	(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)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Efficiency of water heater 349.41 (216)

(217)m= 349.41 (217)

349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32	
Total = Sum(219a) _{1...12} =												425.57	(219)

Annual totals

kWh/year kWh/year

Space heating fuel used, main system 1 946.34

Water heating fuel used 425.57

Electricity for pumps, fans and electric keep-hot

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mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31	(231)
Electricity for lighting		238.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1705.85	(338)

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	0.519	=	491.15	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			712.02	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year		sum of (265)...(271) =		885.34	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.71	(273)
El rating (section 14)				88	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-00-04

Address : C-00-04, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a)	2.5 (2a)	132.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	132.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <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>			0 (11)
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 × (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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 × (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.12 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.27 0.26 0.26 0.25 0.24 0.23 0.23 0.23 0.23 0.24 0.25 0.25 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$\times 1/[1/(1.2) + 0.04] =$	7.4		(27)
Windows Type 2			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Floor			53	$\times$	0.12		6.36 (28)
Walls	53.22	8.59	44.63	$\times$	0.18		8.03 (29)
Total area of elements, m²			106.22				(31)

* 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) = 24.23 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 4.06 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 28.29 (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=	11.62	11.49	11.36	10.73	10.6	9.97	9.97	9.84	10.22	10.6	10.86	11.11

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 39.91 39.78 39.65 39.02 38.89 38.26 38.26 38.13 38.51 38.89 39.15 39.4
Average = Sum(39)_{1...12} /12= 38.99 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 0.75 0.75 0.75 0.74 0.73 0.72 0.72 0.72 0.73 0.73 0.74 0.74
Average = Sum(40)_{1...12} /12= 0.74 (40)

DER WorkSheet: New dwelling design stage

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 1.78 (42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ 76.44 (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 $V_{d,m} = \text{factor from Table 1c} \times (43)$													
(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08	
Total = Sum(44) _{1...12} =												917.29	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76	
Total = Sum(45) _{1...12} =												1202.71	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (49)

Energy lost from water storage, kWh/year (48) × (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) × (51) × (52) × (53) = 0 (54)

Enter (50) or (54) in (55) 0.87 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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	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	0	(61)

DER WorkSheet: New dwelling design stage

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=

151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71

 (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	0

 (63)

Output from water heater

(64)m=

151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71

Output from water heater (annual)_{1...12}

1520.04

 (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=

41.46	36.26	37.42	32.62	31.3	27.01	25.03	28.72	29.07	33.87	36.98	40.15

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

14.38	12.77	10.39	7.86	5.88	4.96	5.36	6.97	9.36	11.88	13.87	14.78

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14

 (71)

Water heating gains (Table 5)

(72)m=

55.73	53.96	50.29	45.31	42.07	37.52	33.64	38.61	40.37	45.53	51.35	53.97

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

274.81	273.04	262.93	246.8	230.68	214.97	204.66	209.62	217.82	234.13	252.84	266.61

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>58.6</td></tr></table> (78)	58.6
0.77																		
6.46																		
46.75																		
0.4																		
0.7																		
58.6																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>19.32</td></tr></table> (78)	19.32
0.77																		
2.13																		
46.75																		
0.4																		
0.7																		
19.32																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>95.98</td></tr></table> (78)	95.98
0.77																		
6.46																		
76.57																		
0.4																		
0.7																		
95.98																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>31.65</td></tr></table> (78)	31.65
0.77																		
2.13																		
76.57																		
0.4																		
0.7																		
31.65																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>122.26</td></tr></table> (78)	122.26
0.77																		
6.46																		
97.53																		
0.4																		
0.7																		
122.26																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>40.31</td></tr></table> (78)	40.31
0.77																		
2.13																		
97.53																		
0.4																		
0.7																		
40.31																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>138.18</td></tr></table> (78)	138.18
0.77																		
6.46																		
110.23																		
0.4																		
0.7																		
138.18																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>45.56</td></tr></table> (78)	45.56
0.77																		
2.13																		
110.23																		
0.4																		
0.7																		
45.56																		

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	6.46	x	114.87	x	0.4	x	0.7	=	143.99	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	6.46	x	110.55	x	0.4	x	0.7	=	138.57	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	6.46	x	108.01	x	0.4	x	0.7	=	135.39	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	6.46	x	104.89	x	0.4	x	0.7	=	131.49	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	6.46	x	101.89	x	0.4	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	6.46	x	82.59	x	0.4	x	0.7	=	103.52	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	6.46	x	55.42	x	0.4	x	0.7	=	69.47	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	6.46	x	40.4	x	0.4	x	0.7	=	50.64	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	77.93	127.62	162.57	183.74	191.47	184.26	180.03	174.84	169.82	137.65	92.37	67.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	352.73	400.66	425.5	430.54	422.15	399.23	384.69	384.46	387.64	371.79	345.21	333.94	(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=	0.94	0.92	0.88	0.81	0.72	0.57	0.42	0.44	0.62	0.81	0.91	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.7	19.93	20.21	20.52	20.76	20.93	20.98	20.98	20.89	20.59	20.1	19.65	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.62	20.62	20.63	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.63	20.63	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.91	0.87	0.8	0.7	0.54	0.39	0.41	0.59	0.8	0.91	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.53	18.87	19.27	19.71	20.04	20.25	20.31	20.31	20.21	19.82	19.13	18.47	(90)

fLA = Living area ÷ (4) =

0.53

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.15	19.43	19.77	20.14	20.42	20.61	20.66	20.66	20.57	20.23	19.64	19.1	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.15	19.43	19.77	20.14	20.42	20.61	20.66	20.66	20.57	20.23	19.64	19.1	(93)

8. 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=	0.93	0.89	0.85	0.79	0.69	0.54	0.39	0.41	0.59	0.78	0.89	0.93	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	326.41	357.84	362.02	338.23	290.17	215.06	151.73	158.07	227.82	290.64	307.77	312.11	(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=	592.69	578.08	526.05	438.49	339.29	229.87	155.46	162.48	249.27	374.47	491.05	586.97	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	198.11	148	122.04	72.19	36.54	0	0	0	0	62.37	131.96	204.49	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												975.71	(98)

Space heating requirement in kWh/m²/year

18.41	(99)

9a. Energy requirements – 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 1 100 (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)

198.11	148	122.04	72.19	36.54	0	0	0	0	62.37	131.96	204.49

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

198.11	148	122.04	72.19	36.54	0	0	0	0	62.37	131.96	204.49		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												975.71	(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)

151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71

Efficiency of water heater 349.41 (216)

(217)m= 349.41 (217)

349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	43.4	38.18	39.92	35.54	34.66	30.71	29.26	32.44	32.48	36.87	39.29	42.27	
Total = Sum(219a) _{1...12} =												435.03	(219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1 975.71

Water heating fuel used 435.03

Electricity for pumps, fans and electric keep-hot

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mechanical ventilation - balanced, extract or positive input from outside		101.03	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	101.03	(231)
Electricity for lighting		253.99	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1765.76	(338)

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	0.519	=	506.39	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	225.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			732.17	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	52.44	(267)
Electricity for lighting	(232) x	0.519	=	131.82	(268)
Total CO2, kg/year		sum of (265)...(271) =		916.43	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.29	(273)
El rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson **Stroma Number:** STRO006273
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: C-01-01

Address : C-01-01, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.5 (2a)	185 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	185 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$\times 1/[1/(1.2) + 0.04] =$	7.4		(27)
Windows Type 2			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Windows Type 3			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Walls	78.68	12.85	65.83	$\times 0.18 =$	11.85		(29)
Total area of elements, m²			78.68				(31)

* 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) = 26.56 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.29 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 28.85 (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=	17.1	16.9	16.71	15.74	15.54	14.57	14.57	14.37	14.96	15.54	15.93	16.32

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 45.95 45.76 45.56 44.59 44.39 43.42 43.42 43.23 43.81 44.39 44.78 45.17
Average = Sum(39)_{1...12} /12= 44.54 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 0.62 0.62 0.62 0.6 0.6 0.59 0.59 0.58 0.59 0.6 0.61 0.61
Average = Sum(40)_{1...12} /12= 0.6 (40)

DER WorkSheet: New dwelling design stage

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 2.34 (42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ 89.76 (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 $V_{d,m}$ = factor from Table 1c x (43)													
(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73	
Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8	
Total = Sum(45) _{1...12} =												1412.21	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 201 (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): 0.54 (48)

Temperature factor from Table 2b 0.8694 (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) 0.87 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(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	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	0	(61)

DER WorkSheet: New dwelling design stage

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=

173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75

 (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	0

 (63)

Output from water heater

(64)m=

173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75

Output from water heater (annual)_{1...12}

1729.54

 (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=

48.68	42.58	43.94	38.31	36.76	31.72	29.39	33.73	34.13	39.77	43.42	47.15

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

18.91	16.8	13.66	10.34	7.73	6.53	7.05	9.17	12.3	15.62	18.23	19.44

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57

 (71)

Water heating gains (Table 5)

(72)m=

65.43	63.36	59.06	53.2	49.4	44.05	39.5	45.33	47.4	53.46	60.3	63.37

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

348.88	346.84	333.99	313.33	292.41	272.22	259.09	264.89	275.5	296.36	320.32	338.23

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>10.63</td></tr></table>	10.63	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>8.79</td></tr></table>	8.79	(74)
0.77																			
2.13																			
10.63																			
0.4																			
0.7																			
8.79																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>20.32</td></tr></table>	20.32	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>16.8</td></tr></table>	16.8	(74)
0.77																			
2.13																			
20.32																			
0.4																			
0.7																			
16.8																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>34.53</td></tr></table>	34.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>28.54</td></tr></table>	28.54	(74)
0.77																			
2.13																			
34.53																			
0.4																			
0.7																			
28.54																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>55.46</td></tr></table>	55.46	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>45.85</td></tr></table>	45.85	(74)
0.77																			
2.13																			
55.46																			
0.4																			
0.7																			
45.85																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>74.72</td></tr></table>	74.72	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>61.76</td></tr></table>	61.76	(74)
0.77																			
2.13																			
74.72																			
0.4																			
0.7																			
61.76																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>79.99</td></tr></table>	79.99	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>66.12</td></tr></table>	66.12	(74)
0.77																			
2.13																			
79.99																			
0.4																			
0.7																			
66.12																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>74.68</td></tr></table>	74.68	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>61.73</td></tr></table>	61.73	(74)
0.77																			
2.13																			
74.68																			
0.4																			
0.7																			
61.73																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>59.25</td></tr></table>	59.25	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>48.97</td></tr></table>	48.97	(74)
0.77																			
2.13																			
59.25																			
0.4																			
0.7																			
48.97																			

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	34.32	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	20	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	10.84	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	7.33	(74)
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	41.53	80.84	134.01	199.66	250.26	259.08	245.44	206.78	156.98	95.98	51.66	34.25	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	390.41	427.67	468	512.99	542.68	531.3	504.53	471.67	432.47	392.35	371.99	372.48	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.97	0.95	0.91	0.82	0.68	0.51	0.37	0.41	0.64	0.86	0.95	0.97	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.85	20.02	20.31	20.65	20.87	20.97	20.99	20.99	20.93	20.63	20.2	19.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.69	20.69	20.69	20.7	20.7	20.71	20.71	20.71	20.7	20.7	20.7	20.69	(88)

DER WorkSheet: New dwelling design stage

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.95	0.91	0.81	0.67	0.48	0.35	0.39	0.62	0.85	0.94	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.83	19.08	19.49	19.98	20.28	20.41	20.44	20.44	20.36	19.97	19.35	18.8	(90)

fLA = Living area ÷ (4) =	0.34	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.18	19.4	19.77	20.21	20.48	20.6	20.63	20.63	20.55	20.2	19.64	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.18	19.4	19.77	20.21	20.48	20.6	20.63	20.63	20.55	20.2	19.64	19.15	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.95	0.93	0.89	0.8	0.65	0.48	0.34	0.38	0.61	0.83	0.93	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	371.24	398.09	415.58	408.34	354.96	253.64	173.43	180.48	263.6	327.6	345.02	356.52	(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=	683.59	663.62	604.62	504.32	389.87	260.71	174.84	182.64	282.68	425.98	561.39	675.21	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	232.39	178.44	140.65	69.11	25.97	0	0	0	0	73.19	155.79	237.1	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1112.64	(98)

Space heating requirement in kWh/m²/year

15.04	(99)

9a. Energy requirements – 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

100	(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)

232.39	178.44	140.65	69.11	25.97	0	0	0	0	73.19	155.79	237.1

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

232.39	178.44	140.65	69.11	25.97	0	0	0	0	73.19	155.79	237.1

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1112.64 \quad (211)$$

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	

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

49.62	43.62	45.53	40.44	39.35	34.76	33.01	36.74	36.84	41.95	44.83	48.29

Total = Sum(219a)_{1..12} =

494.99 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1112.64

Water heating fuel used

494.99

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

149.53

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

149.53

(231)

Electricity for lighting

333.97

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2091.12

(238)

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	0.519	= 577.46 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 256.9 (264)
Space and water heating	(261) + (262) + (263) + (264) =		834.36 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 77.6 (267)
Electricity for lighting	(232) x	0.519	= 173.33 (268)
Total CO2, kg/year		sum of (265)...(271) =	1085.29 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.67 (273)
EI rating (section 14)			88 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-01-02

Address : C-01-02, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a)	2.5 (2a)	132.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	132.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <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>			0 (11)
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 × (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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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 × (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$x1/[1/(1.2)+0.04] =$	7.4		(27)
Windows Type 2			2.13	$x1/[1/(1.2)+0.04] =$	2.44		(27)
Windows Type 3			2.13	$x1/[1/(1.2)+0.04] =$	2.44		(27)
Windows Type 4			3.78	$x1/[1/(1.2)+0.04] =$	4.33		(27)
Walls	55.65	14.5	41.15	x 0.18 =	7.41		(29)
Total area of elements, m²			55.65				(31)

* 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) = 24.01 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.21 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 26.22 (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=	12.25	12.11	11.97	11.27	11.13	10.43	10.43	10.29	10.71	11.13	11.41	11.69

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 38.47 38.33 38.19 37.49 37.35 36.66 36.66 36.52 36.93 37.35 37.63 37.91
Average = Sum(39)_{1...12} /12= 37.46 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.73	0.72	0.72	0.71	0.7	0.69	0.69	0.69	0.7	0.7	0.71	0.72		
Average = Sum(40) _{1...12} /12=													0.71	(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

1.78

(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

76.44

(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=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(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=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71	(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=	151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71	
Output from water heater (annual) _{1...12}												1520.04	(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=	41.46	36.26	37.42	32.62	31.3	27.01	25.03	28.72	29.07	33.87	36.98	40.15	(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=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.82	12.27	9.98	7.56	5.65	4.77	5.15	6.7	8.99	11.42	13.32	14.2	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)

Water heating gains (Table 5)

(72)m=	55.73	53.96	50.29	45.31	42.07	37.52	33.64	38.61	40.37	45.53	51.35	53.97	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	274.24	272.54	262.53	246.49	230.45	214.78	204.45	209.35	217.46	233.67	252.3	266.03	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c	=	Gains (W)		
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	3.78	x	46.75	x	0.4	x	0.7	=	34.29	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.4	x	0.7	=	56.16	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.4	x	0.7	=	71.54	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.4	x	0.7	=	80.85	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.4	x	0.7	=	84.25	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.4	x	0.7	=	81.08	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.4	x	0.7	=	79.22	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.4	x	0.7	=	76.94	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.4	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.4	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.4	x	0.7	=	40.65	(78)

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South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>40.4</td></tr></table>	40.4	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>16.7</td></tr></table>	16.7	(78)
0.77																			
2.13																			
40.4																			
0.4																			
0.7																			
16.7																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.78</td></tr></table>	3.78	x	<table><tr><td>40.4</td></tr></table>	40.4	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>29.63</td></tr></table>	29.63	(78)
0.77																			
3.78																			
40.4																			
0.4																			
0.7																			
29.63																			

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	86.35	151.85	217.31	280.23	320.23	319.74	307.58	278.1	239.5	170.7	104.37	73.25	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	360.59	424.39	479.84	526.72	550.69	534.52	512.02	487.44	456.95	404.36	356.67	339.28	(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=	0.94	0.9	0.83	0.72	0.58	0.43	0.31	0.34	0.53	0.77	0.9	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.8	20.07	20.39	20.71	20.89	20.97	20.99	20.99	20.94	20.69	20.2	19.75	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.64	20.64	20.64	20.65	20.65	20.65	20.65	20.66	20.65	20.65	20.64	20.64	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.89	0.82	0.71	0.56	0.41	0.29	0.32	0.5	0.75	0.9	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.7	19.08	19.53	19.97	20.21	20.32	20.34	20.34	20.29	19.96	19.28	18.63	(90)

fLA = Living area ÷ (4) =

0.58

 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.33	19.65	20.03	20.4	20.6	20.7	20.72	20.72	20.66	20.38	19.81	19.28	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.33	19.65	20.03	20.4	20.6	20.7	20.72	20.72	20.66	20.38	19.81	19.28	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.92	0.88	0.81	0.7	0.56	0.41	0.29	0.32	0.5	0.74	0.88	0.93	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	331.88	372.15	388.22	368.23	309.16	218.16	149.74	155.95	230.62	300.23	314.24	315.93	(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=	578.23	565.32	516.58	431	332.57	223.52	150.93	157.62	242.44	365.32	478.36	571.49	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	183.29	129.81	95.51	45.2	17.42	0	0	0	0	48.43	118.17	190.14	

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

827.96

 (98)

Space heating requirement in kWh/m²/year

15.62

 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0

 (201)

DER WorkSheet: New dwelling design stage

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		100	(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)													
183.29	129.81	95.51	45.2	17.42	0	0	0	0	48.43	118.17	190.14		
(211)m = {[[(98)m x (204)] } x 100 ÷ (206)													(211)
183.29	129.81	95.51	45.2	17.42	0	0	0	0	48.43	118.17	190.14		
Total (kWh/year) =Sum(211) _{1..5,10...12} =												827.96	(211)

Space heating fuel (secondary), kWh/month
= {[[(98)m × (201)] } × 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)													
151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71		
Efficiency of water heater												349.41	(216)
(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	43.4	38.18	39.92	35.54	34.66	30.71	29.26	32.44	32.48	36.87	39.29	42.27	
Total = Sum(219a) _{1..12} =												435.03	(219)

Annual totals

		kWh/year	kWh/year
Space heating fuel used, main system 1		827.96	
Water heating fuel used		435.03	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		101.03	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	101.03	(231)
Electricity for lighting		244.06	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1608.08	(338)

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) ×	0.519	=	429.71 (261)
Space heating (secondary)	(215) ×	0.519	=	0 (263)
Water heating	(219) ×	0.519	=	225.78 (264)
Space and water heating	(261) + (262) + (263) + (264) =			655.49 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.519	=	52.44 (267)
Electricity for lighting	(232) ×	0.519	=	126.67 (268)

DER WorkSheet: New dwelling design stage

Total CO2, kg/year	sum of (265)...(271) =	834.6	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	15.75	(273)
El rating (section 14)		89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-01-03

Address : C-01-03, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	32.4	10.55	21.85	x 0.18	= 3.93		(29)
Total area of elements, m²			32.4				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 16.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 1.64 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 17.77 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 29.32 29.19 29.06 28.4 28.27 27.61 27.61 27.48 27.87 28.27 28.53 28.79
Average = Sum(39)_{1...12} /12= 28.36 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 0.59 0.58 0.58 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.57 0.58
Average = Sum(40)_{1...12} /12= 0.57 (40)

DER WorkSheet: New dwelling design stage

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

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

1.69

(42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

74.34

(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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	
Total = Sum(44) _{1...12} =												892.08	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Total = Sum(45) _{1...12} =												1169.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

DER WorkSheet: New dwelling design stage

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=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

 (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	0

 (63)

Output from water heater

(64)m=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Output from water heater (annual)_{1...12}

1486.99

 (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=

40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6

 (71)

Water heating gains (Table 5)

(72)m=

54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>58.6</td></tr></table>	58.6	(78)
0.77																			
6.46																			
46.75																			
0.4																			
0.7																			
58.6																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>19.32</td></tr></table>	19.32	(78)
0.77																			
2.13																			
46.75																			
0.4																			
0.7																			
19.32																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>95.98</td></tr></table>	95.98	(78)
0.77																			
6.46																			
76.57																			
0.4																			
0.7																			
95.98																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>31.65</td></tr></table>	31.65	(78)
0.77																			
2.13																			
76.57																			
0.4																			
0.7																			
31.65																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>122.26</td></tr></table>	122.26	(78)
0.77																			
6.46																			
97.53																			
0.4																			
0.7																			
122.26																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>40.31</td></tr></table>	40.31	(78)
0.77																			
2.13																			
97.53																			
0.4																			
0.7																			
40.31																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>138.18</td></tr></table>	138.18	(78)
0.77																			
6.46																			
110.23																			
0.4																			
0.7																			
138.18																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>45.56</td></tr></table>	45.56	(78)
0.77																			
2.13																			
110.23																			
0.4																			
0.7																			
45.56																			

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	6.46	x	114.87	x	0.4	x	0.7	=	143.99	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	6.46	x	110.55	x	0.4	x	0.7	=	138.57	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	6.46	x	108.01	x	0.4	x	0.7	=	135.39	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	6.46	x	104.89	x	0.4	x	0.7	=	131.49	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	6.46	x	101.89	x	0.4	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	6.46	x	82.59	x	0.4	x	0.7	=	103.52	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	6.46	x	55.42	x	0.4	x	0.7	=	69.47	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	6.46	x	40.4	x	0.4	x	0.7	=	50.64	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	77.93	127.62	162.57	183.74	191.47	184.26	180.03	174.84	169.82	137.65	92.37	67.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	341.22	389.22	414.51	420.26	412.63	390.41	376.29	375.9	378.7	362.11	334.71	322.8	(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=	0.92	0.87	0.81	0.72	0.6	0.44	0.32	0.33	0.49	0.72	0.87	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.22	20.42	20.63	20.82	20.93	20.99	21	21	20.98	20.85	20.53	20.18	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.71	20.71	20.71	20.72	20.72	20.72	20.72	20.73	20.72	20.72	20.71	20.71	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.87	0.81	0.71	0.59	0.43	0.3	0.31	0.48	0.7	0.86	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.39	19.68	19.96	20.23	20.38	20.46	20.47	20.47	20.44	20.28	19.84	19.34	(90)

fLA = Living area ÷ (4) =

0.56

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.85	20.09	20.33	20.56	20.69	20.75	20.76	20.76	20.74	20.59	20.22	19.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.85	20.09	20.33	20.56	20.69	20.75	20.76	20.76	20.74	20.59	20.22	19.81	(93)

8. 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=	0.9	0.86	0.79	0.7	0.58	0.43	0.3	0.32	0.48	0.7	0.85	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	308.06	332.92	329.33	295.5	240.75	167.26	114.5	119.36	180.7	253.08	285.11	295.39	(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=	455.92	443.42	401.86	331.07	254.05	169.86	114.95	119.92	185.08	282.51	374.44	449.46	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	110.01	74.26	53.97	25.61	9.9	0	0	0	0	21.89	64.32	114.63	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

474.59

Space heating requirement in kWh/m²/year

9.49

9a. Energy requirements – 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 1 100 (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)

110.01	74.26	53.97	25.61	9.9	0	0	0	0	21.89	64.32	114.63

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

110.01	74.26	53.97	25.61	9.9	0	0	0	0	21.89	64.32	114.63

Total (kWh/year) =Sum(211)_{1...5,10...12} =

474.59

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	(215)

Total (kWh/year) =Sum(215)_{1...5,10...12} =

0

Water heating

Output from water heater (calculated above)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32	(219)

Total = Sum(219a)_{1...12} =

425.57

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1 474.59

Water heating fuel used 425.57

Electricity for pumps, fans and electric keep-hot

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mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31	(231)
Electricity for lighting		238.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1234.1	(338)

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	0.519	=	246.31	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			467.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year		sum of (265)...(271) =		640.5	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.81	(273)
El rating (section 14)				91	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-01-05

Address : C-01-05, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	76	(1a) x	2.5	(2a) =	190 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			190 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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 <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>			0	(11)
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			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15	(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) =		0.13	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			5.97	x 1/[1/(1.2)+0.04]	= 6.84		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Floor			32	x 0.15	= 4.8		(28)
Walls	39.05	12.19	26.86	x 0.18	= 4.83		(29)
Total area of elements, m²			71.05				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 23.7 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.14 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 25.84 (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=	17.56	17.36	17.16	16.16	15.96	14.96	14.96	14.76	15.36	15.96	16.36	16.76

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	43.4	43.2	43	42	41.8	40.8	40.8	40.6	41.2	41.8	42.2	42.6
Average = Sum(39) _{1...12} /12=												41.95 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.56	0.56		
Average = Sum(40) _{1...12} /12=													0.55	(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

2.38

(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

90.79

(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=	99.87	96.23	92.6	88.97	85.34	81.71	81.71	85.34	88.97	92.6	96.23	99.87		
Total = Sum(44) _{1...12} =													1089.44	(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=	148.1	129.53	133.66	116.53	111.81	96.48	89.41	102.6	103.82	120.99	132.07	143.42		
Total = Sum(45) _{1...12} =													1428.42	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.21	19.43	20.05	17.48	16.77	14.47	13.41	15.39	15.57	18.15	19.81	21.51		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38	(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=	175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38	
Output from water heater (annual) _{1...12}												1745.76	(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=	49.24	43.07	44.44	38.75	37.18	32.08	29.73	34.11	34.52	40.23	43.91	47.69	(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=	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.34	18.07	14.69	11.12	8.32	7.02	7.59	9.86	13.23	16.8	19.61	20.91	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	210.88	213.07	207.55	195.81	180.99	167.07	157.76	155.57	161.09	172.83	187.65	201.57	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	(71)

Water heating gains (Table 5)

(72)m=	66.19	64.09	59.73	53.81	49.97	44.56	39.96	45.85	47.95	54.07	60.99	64.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	356.15	353.96	340.72	319.49	298.02	277.38	264.04	270.02	281.01	302.44	326.99	345.32	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.13	x	10.63	x	0.4	x	0.7	=	4.39	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	8.4	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	14.27	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	30.88	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	33.06	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	30.86	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	24.49	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	17.16	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	10	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	5.42	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	3.66	(74)
South	0.9x	0.77	x	5.97	x	46.75	x	0.4	x	0.7	=	54.16	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	5.97	x	76.57	x	0.4	x	0.7	=	88.7	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	5.97	x	97.53	x	0.4	x	0.7	=	112.99	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	5.97	x	110.23	x	0.4	x	0.7	=	127.7	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	5.97	x	114.87	x	0.4	x	0.7	=	133.07	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	5.97	x	110.55	x	0.4	x	0.7	=	128.06	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	5.97	x	108.01	x	0.4	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	5.97	x	104.89	x	0.4	x	0.7	=	121.51	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	5.97	x	101.89	x	0.4	x	0.7	=	118.03	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	5.97	x	82.59	x	0.4	x	0.7	=	95.67	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	5.97	x	55.42	x	0.4	x	0.7	=	64.2	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	5.97	x	40.4	x	0.4	x	0.7	=	46.8	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 77.88 128.74 167.57 196.18 211.43 206.81 200.63 189.35 177.3 139.8 92.52 67.16 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 434.02 482.7 508.29 515.67 509.44 484.19 464.67 459.38 458.3 442.24 419.51 412.48 (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=	0.95	0.92	0.88	0.81	0.69	0.52	0.38	0.4	0.59	0.81	0.92	0.96

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.08 20.27 20.49 20.73 20.89 20.98 21 20.99 20.96 20.77 20.41 20.05 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.71	20.72	20.72	20.72	20.73	20.73	20.73	20.73	20.73	20.73	20.72	20.72	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.92	0.88	0.8	0.68	0.5	0.36	0.38	0.57	0.8	0.92	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.2	19.47	19.78	20.13	20.35	20.46	20.48	20.48	20.44	20.19	19.68	19.17	(90)

fLA = Living area ÷ (4) =	0.4	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.56	19.79	20.06	20.37	20.57	20.67	20.69	20.69	20.65	20.42	19.97	19.53	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.56	19.79	20.06	20.37	20.57	20.67	20.69	20.69	20.65	20.42	19.97	19.53	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.91	0.86	0.78	0.67	0.5	0.36	0.38	0.56	0.78	0.9	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	406.06	437.15	437.94	404.48	339.84	241.35	165.71	172.73	258.42	345.94	377.85	389.41	(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=	662.14	643.16	583.22	481.67	370.56	247.63	166.84	174.15	269.74	410.55	543.18	652.82	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	190.52	138.44	108.09	55.57	22.86	0	0	0	0	48.07	119.04	195.98	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												878.57	(98)

Space heating requirement in kWh/m²/year

11.56	(99)

9a. Energy requirements – 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

100	(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)

190.52	138.44	108.09	55.57	22.86	0	0	0	0	48.07	119.04	195.98

(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)

190.52	138.44	108.09	55.57	22.86	0	0	0	0	48.07	119.04	195.98

Total (kWh/year) =Sum(211) _{1...5,10...12} =	878.57	(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...5,10...12} =	0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

50.1	44.04	45.97	40.81	39.71	35.08	33.3	37.08	37.18	42.34	45.26	48.76

Total = Sum(219a)_{1..12} =

499.63 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

878.57

Water heating fuel used

499.63

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

144.88 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

144.88 (231)

Electricity for lighting

359.27 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

1882.34 (338)

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	0.519	455.98 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	259.31 (264)
Space and water heating	(261) + (262) + (263) + (264) =		715.29 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	75.19 (267)
Electricity for lighting	(232) x	0.519	186.46 (268)
Total CO2, kg/year		sum of (265)...(271) =	976.94 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.85 (273)
EI rating (section 14)			89 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-01-06

Address : C-01-06, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	81	(1a) x	2.5	(2a) =	202.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			202.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			3.68	x 1/[1/(1.2)+0.04]	= 4.21		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.84	x 1/[1/(1.2)+0.04]	= 3.25		(27)
Floor			81	x 0.15	= 12.15		(28)
Walls	76.78	16.42	60.36	x 0.18	= 10.86		(29)
Total area of elements, m²			157.78				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 41.92 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.75 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.67 (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=	18.72	18.5	18.29	17.22	17.01	15.95	15.95	15.73	16.37	17.01	17.44	17.86

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	63.39	63.18	62.96	61.9	61.69	60.62	60.62	60.41	61.05	61.69	62.11	62.54
Average = Sum(39) _{1...12} /12=												61.84 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.78	0.78	0.78	0.76	0.76	0.75	0.75	0.75	0.75	0.76	0.77	0.77		
	Average = Sum(40) _{1...12} /12=												0.76	(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

2.48

(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

93.14

(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=	102.45	98.73	95	91.27	87.55	83.82	83.82	87.55	91.27	95	98.73	102.45		
	Total = Sum(44) _{1...12} =												1117.64	(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=	151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14		
	Total = Sum(45) _{1...12} =												1465.41	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.88	157.22	164.07	145.63	141.66	125.06	118.67	132.2	132.59	151.08	161.58	174.09	(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=	178.88	157.22	164.07	145.63	141.66	125.06	118.67	132.2	132.59	151.08	161.58	174.09	
Output from water heater (annual) _{1...12}												1782.74	(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=	50.52	44.18	45.59	39.75	38.14	32.91	30.5	35	35.41	41.27	45.05	48.92	(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=	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.2	17.94	14.59	11.04	8.26	6.97	7.53	9.79	13.14	16.68	19.47	20.76	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	221.52	223.82	218.02	205.69	190.13	175.5	165.72	163.42	169.22	181.55	197.11	211.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)

Water heating gains (Table 5)

(72)m=	67.9	65.75	61.28	55.21	51.26	45.71	40.99	47.04	49.19	55.47	62.57	65.76	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	369.84	367.73	354.12	332.17	309.87	288.4	274.47	280.47	291.77	313.93	339.38	358.48	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.13	x	10.63	x	0.4	x	0.7	=	8.79	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	16.8	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	28.54	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	45.85	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	61.76	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	66.12	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	61.73	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	48.97	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	34.32	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	20	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	10.84	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	7.33	(74)
East	0.9x	0.77	x	2.84	x	19.64	x	0.4	x	0.7	=	10.82	(76)
East	0.9x	0.77	x	2.84	x	38.42	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	2.84	x	63.27	x	0.4	x	0.7	=	34.87	(76)
East	0.9x	0.77	x	2.84	x	92.28	x	0.4	x	0.7	=	50.85	(76)
East	0.9x	0.77	x	2.84	x	113.09	x	0.4	x	0.7	=	62.32	(76)
East	0.9x	0.77	x	2.84	x	115.77	x	0.4	x	0.7	=	63.8	(76)
East	0.9x	0.77	x	2.84	x	110.22	x	0.4	x	0.7	=	60.74	(76)
East	0.9x	0.77	x	2.84	x	94.68	x	0.4	x	0.7	=	52.17	(76)
East	0.9x	0.77	x	2.84	x	73.59	x	0.4	x	0.7	=	40.55	(76)
East	0.9x	0.77	x	2.84	x	45.59	x	0.4	x	0.7	=	25.12	(76)
East	0.9x	0.77	x	2.84	x	24.49	x	0.4	x	0.7	=	13.5	(76)
East	0.9x	0.77	x	2.84	x	16.15	x	0.4	x	0.7	=	8.9	(76)
West	0.9x	0.77	x	3.68	x	19.64	x	0.4	x	0.7	=	28.05	(80)
West	0.9x	0.77	x	3.68	x	38.42	x	0.4	x	0.7	=	54.87	(80)
West	0.9x	0.77	x	3.68	x	63.27	x	0.4	x	0.7	=	90.36	(80)
West	0.9x	0.77	x	3.68	x	92.28	x	0.4	x	0.7	=	131.79	(80)
West	0.9x	0.77	x	3.68	x	113.09	x	0.4	x	0.7	=	161.51	(80)
West	0.9x	0.77	x	3.68	x	115.77	x	0.4	x	0.7	=	165.34	(80)
West	0.9x	0.77	x	3.68	x	110.22	x	0.4	x	0.7	=	157.41	(80)
West	0.9x	0.77	x	3.68	x	94.68	x	0.4	x	0.7	=	135.21	(80)
West	0.9x	0.77	x	3.68	x	73.59	x	0.4	x	0.7	=	105.1	(80)
West	0.9x	0.77	x	3.68	x	45.59	x	0.4	x	0.7	=	65.11	(80)
West	0.9x	0.77	x	3.68	x	24.49	x	0.4	x	0.7	=	34.97	(80)
West	0.9x	0.77	x	3.68	x	16.15	x	0.4	x	0.7	=	23.07	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 47.66 92.84 153.77 228.49 285.59 295.25 279.87 236.36 179.97 110.23 59.31 39.29 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 417.5 460.57 507.89 560.66 595.46 583.65 554.34 516.83 471.73 424.15 398.69 397.78 (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=	0.97	0.96	0.93	0.87	0.76	0.6	0.46	0.51	0.73	0.9	0.96	0.98

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.35 19.55 19.89 20.34 20.69 20.9 20.97 20.96 20.8 20.34 19.78 19.32 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.61	20.61	20.61	20.62	20.62	20.63	20.63	20.63	20.62	20.62	20.62	20.61	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.93	0.86	0.74	0.57	0.43	0.47	0.71	0.89	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.02	18.3	18.8	19.44	19.93	20.2	20.28	20.27	20.09	19.46	18.65	17.98	(90)

fLA = Living area ÷ (4) =	0.37	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.51	18.76	19.2	19.77	20.21	20.46	20.53	20.52	20.35	19.78	19.07	18.47	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.51	18.76	19.2	19.77	20.21	20.46	20.53	20.52	20.35	19.78	19.07	18.47	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.91	0.84	0.72	0.56	0.42	0.46	0.69	0.87	0.94	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	400.07	434	461.66	470.26	430.64	327.55	230.99	238.54	324.28	369.52	375.16	383.22	(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, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	900.85	875.78	799.71	672.9	524.83	355.37	238.4	249.09	381.55	566.51	743.22	892.68	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	372.58	296.87	251.51	145.9	70.07	0	0	0	0	146.56	265	379.04	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1927.54	(98)

Space heating requirement in kWh/m²/year

23.8	(99)

9a. Energy requirements – 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

100	(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)

372.58	296.87	251.51	145.9	70.07	0	0	0	0	146.56	265	379.04

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

372.58	296.87	251.51	145.9	70.07	0	0	0	0	146.56	265	379.04

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1927.54 \quad (211)$$

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...5,10...12} =												0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

178.88	157.22	164.07	145.63	141.66	125.06	118.67	132.2	132.59	151.08	161.58	174.09

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

51.2	45	46.96	41.68	40.54	35.79	33.96	37.84	37.95	43.24	46.24	49.82

Total = Sum(219a)_{1..12} =

510.21 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1927.54

Water heating fuel used

510.21

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

154.41 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

154.41 (231)

Electricity for lighting

356.69 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2948.84 (338)

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	0.519	= 1000.39 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 264.8 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1265.19 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 80.14 (267)
Electricity for lighting	(232) x	0.519	= 185.12 (268)
Total CO2, kg/year		sum of (265)...(271) =	1530.45 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	18.89 (273)
EI rating (section 14)			84 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-02-01

Address : C-02-01, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	74	(1a) x	2.5	(2a) =	185 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			185 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$\times 1/[1/(1.2) + 0.04] =$	7.4		(27)
Windows Type 2			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Windows Type 3			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Walls	78.68	12.85	65.83	$\times 0.18 =$	11.85		(29)
Roof	74	0	74	$\times 0.14 =$	10.36		(30)
Total area of elements, m²			152.68				(31)

* 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) = 36.92 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 4.81 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.73 (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=	17.1	16.9	16.71	15.74	15.54	14.57	14.57	14.37	14.96	15.54	15.93	16.32

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 58.83 58.63 58.44 57.47 57.27 56.3 56.3 56.1 56.69 57.27 57.66 58.05
Average = Sum(39)_{1...12} /12= 57.42 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.79	0.79	0.79	0.78	0.77	0.76	0.76	0.76	0.77	0.77	0.78	0.78		
	Average = Sum(40) _{1...12} /12=												0.78	(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

2.34

(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

89.76

(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=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(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=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	(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=	173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75	
Output from water heater (annual) _{1...12}												1729.54	(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=	48.68	42.58	43.94	38.31	36.76	31.72	29.39	33.73	34.13	39.77	43.42	47.15	(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=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.91	16.8	13.66	10.34	7.73	6.53	7.05	9.17	12.3	15.62	18.23	19.44	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)

Water heating gains (Table 5)

(72)m=	65.43	63.36	59.06	53.2	49.4	44.05	39.5	45.33	47.4	53.46	60.3	63.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	348.88	346.84	333.99	313.33	292.41	272.22	259.09	264.89	275.5	296.36	320.32	338.23	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.13	x	10.63	x	0.4	x	0.7	=	8.79	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	16.8	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	28.54	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	45.85	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	61.76	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	66.12	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	61.73	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	48.97	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	34.32	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	20	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	10.84	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	7.33	(74)
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)
East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 41.53 80.84 134.01 199.66 250.26 259.08 245.44 206.78 156.98 95.98 51.66 34.25 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 390.41 427.67 468 512.99 542.68 531.3 504.53 471.67 432.47 392.35 371.99 372.48 (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=	0.97	0.96	0.93	0.87	0.77	0.61	0.47	0.51	0.73	0.9	0.96	0.98

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.34 19.53 19.87 20.31 20.67 20.9 20.97 20.96 20.79 20.33 19.77 19.31 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.6	20.6	20.61	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.61	20.61	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.93	0.86	0.75	0.58	0.43	0.48	0.71	0.89	0.96	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18	18.27	18.76	19.4	19.9	20.19	20.26	20.25	20.06	19.43	18.63	17.96	(90)

fLA = Living area ÷ (4) =	0.34	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.45	18.7	19.14	19.71	20.16	20.43	20.5	20.49	20.31	19.74	19.02	18.42	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.45	18.7	19.14	19.71	20.16	20.43	20.5	20.49	20.31	19.74	19.02	18.42	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.91	0.84	0.73	0.57	0.42	0.47	0.69	0.87	0.94	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	373.1	402.05	424.77	430.7	394.41	300.9	212.42	219.35	297.84	340.87	348.92	357.93	(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=	832.63	809.18	738.54	621.3	484.54	328.07	219.75	229.67	352.19	523.35	687.04	825.29	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	341.89	273.59	233.44	137.23	67.06	0	0	0	0	135.76	243.45	347.72	(98)

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1780.14	(98)

Space heating requirement in kWh/m²/year

24.06	(99)

9a. Energy requirements – 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

100	(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)

341.89	273.59	233.44	137.23	67.06	0	0	0	0	135.76	243.45	347.72

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

341.89	273.59	233.44	137.23	67.06	0	0	0	0	135.76	243.45	347.72

Total (kWh/year) =Sum(211) _{1...5,10...12} =	1780.14	(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	0	(215)

Total (kWh/year) =Sum(215) _{1...5,10...12} =	0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

173.37	152.4	159.09	141.29	137.49	121.47	115.34	128.38	128.72	146.57	156.66	168.75

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

49.62	43.62	45.53	40.44	39.35	34.76	33.01	36.74	36.84	41.95	44.83	48.29

Total = Sum(219a)_{1..12} =

494.99 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1780.14

Water heating fuel used

494.99

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

149.53 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

149.53 (231)

Electricity for lighting

333.97 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2758.63 (338)

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	0.519	= 923.89 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 256.9 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1180.79 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 77.6 (267)
Electricity for lighting	(232) x	0.519	= 173.33 (268)
Total CO2, kg/year		sum of (265)...(271) =	1431.73 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	19.35 (273)
EI rating (section 14)			84 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-02-02

Address : C-02-02, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	53	(1a) x	2.5	(2a) =	132.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			132.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$\times 1/[1/(1.2) + 0.04] =$	7.4		(27)
Windows Type 2			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Windows Type 3			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Windows Type 4			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33		(27)
Walls	55.65	14.5	41.15	x 0.18 =	7.41		(29)
Roof	53	0	53	x 0.14 =	7.42		(30)
Total area of elements, m²			108.65				(31)

* 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) = 31.43 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.99 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 35.42 (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=	12.25	12.11	11.97	11.27	11.13	10.43	10.43	10.29	10.71	11.13	11.41	11.69

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	47.67	47.53	47.39	46.69	46.55	45.86	45.86	45.72	46.13	46.55	46.83	47.11
Average = Sum(39) _{1...12} /12=												46.66 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.9	0.9	0.89	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.88	0.89		
Average = Sum(40) _{1...12} /12=													0.88	(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

1.78

(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

76.44

(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=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(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=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71	(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=	151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71	
Output from water heater (annual) _{1...12}												1520.04	(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=	41.46	36.26	37.42	32.62	31.3	27.01	25.03	28.72	29.07	33.87	36.98	40.15	(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=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.82	12.27	9.98	7.56	5.65	4.77	5.15	6.7	8.99	11.42	13.32	14.2	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)

Water heating gains (Table 5)

(72)m=	55.73	53.96	50.29	45.31	42.07	37.52	33.64	38.61	40.37	45.53	51.35	53.97	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	274.24	272.54	262.53	246.49	230.45	214.78	204.45	209.35	217.46	233.67	252.3	266.03	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c	=	Gains (W)	
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62 (76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12 (76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16 (76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88 (76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31 (76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	3.78	x	46.75	x	0.4	x	0.7	=	34.29	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.4	x	0.7	=	56.16	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.4	x	0.7	=	71.54	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.4	x	0.7	=	80.85	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.4	x	0.7	=	84.25	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.4	x	0.7	=	81.08	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.4	x	0.7	=	79.22	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.4	x	0.7	=	76.94	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.4	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.4	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.4	x	0.7	=	40.65	(78)

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South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.4	x	0.7	=	29.63	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	86.35	151.85	217.31	280.23	320.23	319.74	307.58	278.1	239.5	170.7	104.37	73.25	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	360.59	424.39	479.84	526.72	550.69	534.52	512.02	487.44	456.95	404.36	356.67	339.28	(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=	0.95	0.92	0.87	0.78	0.66	0.51	0.38	0.41	0.61	0.82	0.92	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.33	19.61	20	20.43	20.74	20.92	20.97	20.97	20.85	20.43	19.81	19.27	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.55	20.55	20.55	20.56	20.56	20.57	20.57	20.57	20.56	20.56	20.56	20.56	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.91	0.86	0.77	0.64	0.48	0.35	0.38	0.58	0.81	0.92	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.33	18.88	19.48	19.89	20.12	20.18	20.18	20.04	19.5	18.62	17.84	(90)

fLA = Living area ÷ (4) =

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.73	19.07	19.53	20.03	20.38	20.58	20.64	20.63	20.51	20.04	19.3	18.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.73	19.07	19.53	20.03	20.38	20.58	20.64	20.63	20.51	20.04	19.3	18.66	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.93	0.89	0.84	0.75	0.63	0.48	0.35	0.38	0.58	0.79	0.9	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	334.93	379.39	402.99	395.61	347.01	256.67	180.22	186.92	263.57	318.22	320.22	318.22	(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, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	687.72	673.47	617.31	519.64	404.14	274.19	185.13	193.43	295.6	439.3	571.43	681.4	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	262.48	197.62	159.46	89.31	42.51	0	0	0	0	90.08	180.87	270.21	

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = (98)

Space heating requirement in kWh/m²/year

(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

(201)

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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		100	(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)

262.48	197.62	159.46	89.31	42.51	0	0	0	0	90.08	180.87	270.21

(211)m = {[[(98)m × (204)] } × 100 ÷ (206)

(211)

262.48	197.62	159.46	89.31	42.51	0	0	0	0	90.08	180.87	270.21

Total (kWh/year) = Sum(211)_{1...5,10...12} =

1292.53 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m × (201)] } × 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)

151.65	133.4	139.49	124.2	121.09	107.32	102.23	113.34	113.5	128.83	137.29	147.71

Efficiency of water heater

349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41

(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	43.4	38.18	39.92	35.54	34.66	30.71	29.26	32.44	32.48	36.87	39.29	42.27

Total = Sum(219a)_{1...12} =

435.03 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1292.53

Water heating fuel used

435.03

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

101.03 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

101.03 (231)

Electricity for lighting

244.06 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2072.66 (238)

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) ×	0.519	=	670.83 (261)
Space heating (secondary)	(215) ×	0.519	=	0 (263)
Water heating	(219) ×	0.519	=	225.78 (264)
Space and water heating	(261) + (262) + (263) + (264) =			896.61 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.519	=	52.44 (267)
Electricity for lighting	(232) ×	0.519	=	126.67 (268)

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Total CO2, kg/year	sum of (265)...(271) =	1075.71	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	20.3	(273)
El rating (section 14)		85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-02-05

Address : C-02-05, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	76	(1a) x	2.5	(2a) =	190 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			190 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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 <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>			0	(11)
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			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15	(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) =		0.13	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			5.97	x1/[1/(1.2)+ 0.04] =	6.84		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04] =	2.44		(27)
Windows Type 3			2.13	x1/[1/(1.2)+ 0.04] =	2.44		(27)
Walls	39.05	12.19	26.86	x 0.18	= 4.83		(29)
Total area of elements, m²			39.05				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 18.9 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.14 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.04 (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=	17.56	17.36	17.16	16.16	15.96	14.96	14.96	14.76	15.36	15.96	16.36	16.76

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 38.6 38.4 38.2 37.2 37 36 36 35.8 36.4 37 37.4 37.8
Average = Sum(39)_{1...12} /12= 37.15 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.51	0.51	0.5	0.49	0.49	0.47	0.47	0.47	0.48	0.49	0.49	0.5		
	Average = Sum(40) _{1...12} /12=												0.49	(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

2.38

(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

90.79

(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=	99.87	96.23	92.6	88.97	85.34	81.71	81.71	85.34	88.97	92.6	96.23	99.87		
	Total = Sum(44) _{1...12} =												1089.44	(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=	148.1	129.53	133.66	116.53	111.81	96.48	89.41	102.6	103.82	120.99	132.07	143.42		
	Total = Sum(45) _{1...12} =												1428.42	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.21	19.43	20.05	17.48	16.77	14.47	13.41	15.39	15.57	18.15	19.81	21.51		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38	(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=	175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38	
Output from water heater (annual) _{1...12}												1745.76	(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=	49.24	43.07	44.44	38.75	37.18	32.08	29.73	34.11	34.52	40.23	43.91	47.69	(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=	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.34	18.07	14.69	11.12	8.32	7.02	7.59	9.86	13.23	16.8	19.61	20.91	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	210.88	213.07	207.55	195.81	180.99	167.07	157.76	155.57	161.09	172.83	187.65	201.57	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	(71)

Water heating gains (Table 5)

(72)m=	66.19	64.09	59.73	53.81	49.97	44.56	39.96	45.85	47.95	54.07	60.99	64.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	356.15	353.96	340.72	319.49	298.02	277.38	264.04	270.02	281.01	302.44	326.99	345.32	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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	2.13	x	10.63	x	0.4	x	0.7	=	4.39	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	8.4	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	14.27	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	30.88	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	33.06	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	30.86	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	24.49	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	17.16	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	10	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	5.42	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	3.66	(74)
South	0.9x	0.77	x	5.97	x	46.75	x	0.4	x	0.7	=	54.16	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	5.97	x	76.57	x	0.4	x	0.7	=	88.7	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	5.97	x	97.53	x	0.4	x	0.7	=	112.99	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	5.97	x	110.23	x	0.4	x	0.7	=	127.7	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	5.97	x	114.87	x	0.4	x	0.7	=	133.07	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	5.97	x	110.55	x	0.4	x	0.7	=	128.06	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	5.97	x	108.01	x	0.4	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	5.97	x	104.89	x	0.4	x	0.7	=	121.51	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	5.97	x	101.89	x	0.4	x	0.7	=	118.03	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	5.97	x	82.59	x	0.4	x	0.7	=	95.67	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	5.97	x	55.42	x	0.4	x	0.7	=	64.2	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	5.97	x	40.4	x	0.4	x	0.7	=	46.8	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 77.88 128.74 167.57 196.18 211.43 206.81 200.63 189.35 177.3 139.8 92.52 67.16 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 434.02 482.7 508.29 515.67 509.44 484.19 464.67 459.38 458.3 442.24 419.51 412.48 (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=	0.94	0.91	0.86	0.77	0.64	0.47	0.34	0.36	0.53	0.77	0.9	0.95

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.29 20.46 20.64 20.83 20.94 20.99 21 21 20.98 20.86 20.57 20.26 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.75	20.75	20.75	20.76	20.76	20.76	20.76	20.76	20.76	20.76	20.75	20.75	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.9	0.85	0.76	0.62	0.45	0.32	0.34	0.52	0.75	0.9	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.54	19.78	20.05	20.32	20.47	20.54	20.54	20.55	20.52	20.36	19.96	19.51	(90)

fLA = Living area ÷ (4) =	0.4	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.84	20.05	20.29	20.53	20.66	20.72	20.73	20.73	20.71	20.56	20.2	19.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.84	20.05	20.29	20.53	20.66	20.72	20.73	20.73	20.71	20.56	20.2	19.81	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.93	0.89	0.84	0.75	0.62	0.45	0.32	0.34	0.51	0.74	0.88	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	402.23	430.02	426.13	385.38	315.41	217.71	148.18	154.44	235.36	329.34	370.83	386.23	(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=	599.84	581.86	526.62	432.47	331.41	220.25	148.55	154.93	240.43	368.52	490.03	590.16	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	147.02	102.04	74.76	33.91	11.9	0	0	0	0	29.14	85.82	151.72	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												636.32	(98)

Space heating requirement in kWh/m²/year

8.37	(99)

9a. Energy requirements – 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

100	(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)

147.02	102.04	74.76	33.91	11.9	0	0	0	0	29.14	85.82	151.72

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

147.02	102.04	74.76	33.91	11.9	0	0	0	0	29.14	85.82	151.72

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 636.32 \quad (211)$$

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	

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} = 0 \quad (215)$$

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Water heating

Output from water heater (calculated above)

175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

50.1	44.04	45.97	40.81	39.71	35.08	33.3	37.08	37.18	42.34	45.26	48.76

Total = Sum(219a)_{1..12} =

499.63 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

636.32

Water heating fuel used

499.63

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

144.88 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

144.88 (231)

Electricity for lighting

359.27 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

1640.09 (338)

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	0.519	= 330.25 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 259.31 (264)
Space and water heating	(261) + (262) + (263) + (264) =		589.56 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 75.19 (267)
Electricity for lighting	(232) x	0.519	= 186.46 (268)
Total CO2, kg/year		sum of (265)...(271) =	851.21 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	11.2 (273)
EI rating (section 14)			91 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-02-06

Address : C-02-06, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	81 (1a)	2.5 (2a)	202.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	202.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			3.68	x 1/[1/(1.2)+0.04]	= 4.21		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.84	x 1/[1/(1.2)+0.04]	= 3.25		(27)
Walls	76.78	16.42	60.36	x 0.18	= 10.86		(29)
Roof	17	0	17	x 0.14	= 2.38		(30)
Total area of elements, m²			93.78				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 32.15 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.75 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.9 (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=	18.72	18.5	18.29	17.22	17.01	15.95	15.95	15.73	16.37	17.01	17.44	17.86

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	53.62	53.41	53.19	52.13	51.92	50.85	50.85	50.64	51.28	51.92	52.34	52.77
Average = Sum(39) _{1...12} /12=												52.07 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.66	0.66	0.66	0.64	0.64	0.63	0.63	0.63	0.63	0.64	0.65	0.65		
	Average = Sum(40) _{1...12} /12=												0.64	(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

2.48

(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

93.14

(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=	102.45	98.73	95	91.27	87.55	83.82	83.82	87.55	91.27	95	98.73	102.45		
	Total = Sum(44) _{1...12} =												1117.64	(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=	151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14		
	Total = Sum(45) _{1...12} =												1465.41	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.88	157.22	164.07	145.63	141.66	125.06	118.67	132.2	132.59	151.08	161.58	174.09	(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=	178.88	157.22	164.07	145.63	141.66	125.06	118.67	132.2	132.59	151.08	161.58	174.09	
Output from water heater (annual) _{1...12}												1782.74	(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=	50.52	44.18	45.59	39.75	38.14	32.91	30.5	35	35.41	41.27	45.05	48.92	(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=	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	124.08	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.2	17.94	14.59	11.04	8.26	6.97	7.53	9.79	13.14	16.68	19.47	20.76	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	221.52	223.82	218.02	205.69	190.13	175.5	165.72	163.42	169.22	181.55	197.11	211.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	35.41	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)

Water heating gains (Table 5)

(72)m=	67.9	65.75	61.28	55.21	51.26	45.71	40.99	47.04	49.19	55.47	62.57	65.76	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	369.84	367.73	354.12	332.17	309.87	288.4	274.47	280.47	291.77	313.93	339.38	358.48	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.13	x	10.63	x	0.4	x	0.7	=	8.79	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	16.8	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	28.54	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	45.85	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	61.76	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	66.12	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	61.73	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	48.97	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	34.32	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	20	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	10.84	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	7.33	(74)
East	0.9x	0.77	x	2.84	x	19.64	x	0.4	x	0.7	=	10.82	(76)
East	0.9x	0.77	x	2.84	x	38.42	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	2.84	x	63.27	x	0.4	x	0.7	=	34.87	(76)
East	0.9x	0.77	x	2.84	x	92.28	x	0.4	x	0.7	=	50.85	(76)
East	0.9x	0.77	x	2.84	x	113.09	x	0.4	x	0.7	=	62.32	(76)
East	0.9x	0.77	x	2.84	x	115.77	x	0.4	x	0.7	=	63.8	(76)
East	0.9x	0.77	x	2.84	x	110.22	x	0.4	x	0.7	=	60.74	(76)
East	0.9x	0.77	x	2.84	x	94.68	x	0.4	x	0.7	=	52.17	(76)
East	0.9x	0.77	x	2.84	x	73.59	x	0.4	x	0.7	=	40.55	(76)
East	0.9x	0.77	x	2.84	x	45.59	x	0.4	x	0.7	=	25.12	(76)
East	0.9x	0.77	x	2.84	x	24.49	x	0.4	x	0.7	=	13.5	(76)
East	0.9x	0.77	x	2.84	x	16.15	x	0.4	x	0.7	=	8.9	(76)
West	0.9x	0.77	x	3.68	x	19.64	x	0.4	x	0.7	=	28.05	(80)
West	0.9x	0.77	x	3.68	x	38.42	x	0.4	x	0.7	=	54.87	(80)
West	0.9x	0.77	x	3.68	x	63.27	x	0.4	x	0.7	=	90.36	(80)
West	0.9x	0.77	x	3.68	x	92.28	x	0.4	x	0.7	=	131.79	(80)
West	0.9x	0.77	x	3.68	x	113.09	x	0.4	x	0.7	=	161.51	(80)
West	0.9x	0.77	x	3.68	x	115.77	x	0.4	x	0.7	=	165.34	(80)
West	0.9x	0.77	x	3.68	x	110.22	x	0.4	x	0.7	=	157.41	(80)
West	0.9x	0.77	x	3.68	x	94.68	x	0.4	x	0.7	=	135.21	(80)
West	0.9x	0.77	x	3.68	x	73.59	x	0.4	x	0.7	=	105.1	(80)
West	0.9x	0.77	x	3.68	x	45.59	x	0.4	x	0.7	=	65.11	(80)
West	0.9x	0.77	x	3.68	x	24.49	x	0.4	x	0.7	=	34.97	(80)
West	0.9x	0.77	x	3.68	x	16.15	x	0.4	x	0.7	=	23.07	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 47.66 92.84 153.77 228.49 285.59 295.25 279.87 236.36 179.97 110.23 59.31 39.29 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 417.5 460.57 507.89 560.66 595.46 583.65 554.34 516.83 471.73 424.15 398.69 397.78 (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=	0.97	0.95	0.92	0.84	0.71	0.53	0.4	0.44	0.67	0.88	0.95	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.7 19.88 20.19 20.57 20.83 20.96 20.99 20.99 20.9 20.55 20.07 19.67 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.67	20.67	20.67	20.68	20.68	20.69	20.69	20.69	20.68	20.68	20.68	20.67	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.92	0.83	0.69	0.51	0.37	0.41	0.65	0.87	0.95	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.59	18.86	19.3	19.85	20.2	20.36	20.4	20.4	20.29	19.83	19.14	18.56	(90)

fLA = Living area ÷ (4) =	0.37	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19	19.24	19.63	20.11	20.43	20.58	20.62	20.61	20.52	20.1	19.49	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19	19.24	19.63	20.11	20.43	20.58	20.62	20.61	20.52	20.1	19.49	18.97	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.9	0.81	0.68	0.5	0.36	0.41	0.64	0.85	0.94	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	399.05	431.58	455.61	454.82	402.42	292.71	201.7	209.53	299.88	360.79	372.83	382.49	(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=	788.2	765.77	698.52	584.55	453.27	304.29	204.21	213.33	329.02	493.05	648.31	779.26	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	289.53	224.58	180.72	93.41	37.83	0	0	0	0	98.4	198.35	295.19	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1418.01	(98)

Space heating requirement in kWh/m²/year

17.51	(99)

9a. Energy requirements – 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

100	(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)

289.53	224.58	180.72	93.41	37.83	0	0	0	0	98.4	198.35	295.19

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

289.53	224.58	180.72	93.41	37.83	0	0	0	0	98.4	198.35	295.19

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1418.01 \quad (211)$$

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...5,10...12} =												0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

178.88	157.22	164.07	145.63	141.66	125.06	118.67	132.2	132.59	151.08	161.58	174.09

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

51.2	45	46.96	41.68	40.54	35.79	33.96	37.84	37.95	43.24	46.24	49.82

Total = Sum(219a)_{1..12} =

510.21 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1418.01

Water heating fuel used

510.21

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

154.41

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

154.41

(231)

Electricity for lighting

356.69

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2439.32

(238)

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	0.519	=	735.95	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	264.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1000.75	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	80.14	(267)
Electricity for lighting	(232) x	0.519	=	185.12	(268)
Total CO2, kg/year		sum of (265)...(271) =		1266.01	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.63	(273)
EI rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-03-01

Address : C-03-01, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	61 (1a) x	2.5 (2a) =	152.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.5 (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 <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>		0 (11)
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		3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15 (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) =	0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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
Windows Type 1			6.46	$\times 1/[1/(1.2) + 0.04] =$	7.4		(27)
Windows Type 2			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Windows Type 3			2.13	$\times 1/[1/(1.2) + 0.04] =$	2.44		(27)
Walls	60.75	14.98	45.77	$\times 0.18 =$	8.24		(29)
Roof	61	0	61	$\times 0.14 =$	8.54		(30)
Total area of elements, m²			121.75				(31)

* 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) = 33.93 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 5.01 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 38.94 (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=	14.09	13.93	13.77	12.97	12.81	12.01	12.01	11.85	12.33	12.81	13.13	13.45

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 53.04 52.88 52.71 51.91 51.75 50.95 50.95 50.79 51.27 51.75 52.07 52.39
Average = Sum(39)_{1...12} /12= 51.87 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.87	0.87	0.86	0.85	0.85	0.84	0.84	0.83	0.84	0.85	0.85	0.86		
	Average = Sum(40) _{1...12} /12=												0.85	(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

2.01

(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

81.93

(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=	90.13	86.85	83.57	80.29	77.02	73.74	73.74	77.02	80.29	83.57	86.85	90.13		
	Total = Sum(44) _{1...12} =												983.18	(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=	133.65	116.89	120.62	105.16	100.91	87.07	80.69	92.59	93.7	109.19	119.19	129.44		
	Total = Sum(45) _{1...12} =												1289.11	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.05	17.53	18.09	15.77	15.14	13.06	12.1	13.89	14.05	16.38	17.88	19.42		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	160.6	141.24	147.58	131.24	127.86	113.16	107.64	119.54	119.78	136.14	145.27	156.39	(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=	160.6	141.24	147.58	131.24	127.86	113.16	107.64	119.54	119.78	136.14	145.27	156.39	
Output from water heater (annual) _{1...12}												1606.44	(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=	44.44	38.87	40.11	34.97	33.55	28.95	26.83	30.79	31.15	36.31	39.63	43.04	(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=	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.64	13.89	11.3	8.55	6.39	5.4	5.83	7.58	10.18	12.92	15.08	16.08	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	175.46	177.28	172.69	162.93	150.6	139.01	131.27	129.45	134.03	143.8	156.13	167.72	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	(71)

Water heating gains (Table 5)

(72)m=	59.73	57.84	53.91	48.56	45.1	40.21	36.06	41.38	43.27	48.8	55.04	57.85	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	303.98	302.16	291.05	273.19	255.23	237.76	226.31	231.55	240.63	258.67	279.4	294.79	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(76)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	38.65	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	63.29	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	80.62	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	91.12	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	94.95	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	91.38	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	89.28	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	86.71	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	84.22	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	68.27	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	45.81	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	33.39	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 79.5 143.21 212.24 283.07 330.2 332.2 318.55 283.64 237.29 163.1 96.75 66.99 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 383.48 445.37 503.29 556.27 585.43 569.96 544.86 515.2 477.92 421.77 376.15 361.78 (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=	0.96	0.93	0.89	0.8	0.68	0.53	0.4	0.43	0.64	0.84	0.94	0.96

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.32 19.58 19.97 20.41 20.73 20.92 20.97 20.97 20.84 20.4 19.79 19.27 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.57	20.57	20.57	20.57	20.58	20.58	20.58	20.58	20.58	20.58	20.57	20.57	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.88	0.79	0.66	0.5	0.36	0.4	0.61	0.83	0.93	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.31	18.86	19.48	19.91	20.14	20.2	20.2	20.06	19.48	18.61	17.86	(90)

fLA = Living area ÷ (4) =	0.43	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.53	18.86	19.34	19.88	20.27	20.48	20.54	20.53	20.4	19.88	19.12	18.47	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.53	18.86	19.34	19.88	20.27	20.48	20.54	20.53	20.4	19.88	19.12	18.47	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.91	0.86	0.77	0.65	0.49	0.36	0.39	0.6	0.81	0.91	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	359.34	404.05	431.34	428.23	378.7	280.32	195.52	202.85	285.92	340.77	342.21	341.92	(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=	754.63	738.25	676.81	570.14	443.3	299.54	200.7	209.89	322.83	480.47	625.94	747.67	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	294.09	224.58	182.63	102.18	48.06	0	0	0	0	103.94	204.29	301.88	(98)

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1461.66	(98)

Space heating requirement in kWh/m²/year

23.96	(99)

9a. Energy requirements – 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

100	(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)

294.09	224.58	182.63	102.18	48.06	0	0	0	0	103.94	204.29	301.88

(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)

294.09	224.58	182.63	102.18	48.06	0	0	0	0	103.94	204.29	301.88

Total (kWh/year) =Sum(211) _{1...5,10...12} =	1461.66	(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	(215)

Total (kWh/year) =Sum(215) _{1...5,10...12} =	0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

160.6	141.24	147.58	131.24	127.86	113.16	107.64	119.54	119.78	136.14	145.27	156.39

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

45.96	40.42	42.24	37.56	36.59	32.38	30.81	34.21	34.28	38.96	41.58	44.76

Total = Sum(219a)_{1..12} =

459.76 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1461.66

Water heating fuel used

459.76

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

116.28

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

116.28 (231)

Electricity for lighting

276.25 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2313.95 (338)

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	0.519	=	758.6	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	238.61	(264)
Space and water heating	(261) + (262) + (263) + (264) =			997.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	60.35	(267)
Electricity for lighting	(232) x	0.519	=	143.37	(268)
Total CO2, kg/year		sum of (265)...(271) =		1200.94	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		19.69	(273)
EI rating (section 14)				85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-03-02

Address : C-03-02, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	32.4	10.55	21.85	x 0.18	= 3.93		(29)
Total area of elements, m²			32.4				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 16.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 3.93 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 20.05 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 31.6 31.47 31.34 30.68 30.55 29.89 29.89 29.76 30.16 30.55 30.81 31.08
Average = Sum(39)_{1...12} /12= 30.65 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 0.63 0.63 0.63 0.61 0.61 0.6 0.6 0.6 0.6 0.61 0.62 0.62
Average = Sum(40)_{1...12} /12= 0.61 (40)

DER WorkSheet: New dwelling design stage

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

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

1.69

(42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

74.34

(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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	
Total = Sum(44) _{1...12} =												892.08	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Total = Sum(45) _{1...12} =												1169.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

DER WorkSheet: New dwelling design stage

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=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

 (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	0

 (63)

Output from water heater

(64)m=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Output from water heater (annual)_{1...12}

1486.99

 (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=

40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6

 (71)

Water heating gains (Table 5)

(72)m=

54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>58.6</td></tr></table>	58.6	(78)
0.77																			
6.46																			
46.75																			
0.4																			
0.7																			
58.6																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>19.32</td></tr></table>	19.32	(78)
0.77																			
2.13																			
46.75																			
0.4																			
0.7																			
19.32																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>95.98</td></tr></table>	95.98	(78)
0.77																			
6.46																			
76.57																			
0.4																			
0.7																			
95.98																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>31.65</td></tr></table>	31.65	(78)
0.77																			
2.13																			
76.57																			
0.4																			
0.7																			
31.65																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>122.26</td></tr></table>	122.26	(78)
0.77																			
6.46																			
97.53																			
0.4																			
0.7																			
122.26																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>40.31</td></tr></table>	40.31	(78)
0.77																			
2.13																			
97.53																			
0.4																			
0.7																			
40.31																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>138.18</td></tr></table>	138.18	(78)
0.77																			
6.46																			
110.23																			
0.4																			
0.7																			
138.18																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.13</td></tr></table>	2.13	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>45.56</td></tr></table>	45.56	(78)
0.77																			
2.13																			
110.23																			
0.4																			
0.7																			
45.56																			

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	6.46	x	114.87	x	0.4	x	0.7	=	143.99	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	6.46	x	110.55	x	0.4	x	0.7	=	138.57	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	6.46	x	108.01	x	0.4	x	0.7	=	135.39	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	6.46	x	104.89	x	0.4	x	0.7	=	131.49	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	6.46	x	101.89	x	0.4	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	6.46	x	82.59	x	0.4	x	0.7	=	103.52	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	6.46	x	55.42	x	0.4	x	0.7	=	69.47	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	6.46	x	40.4	x	0.4	x	0.7	=	50.64	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	77.93	127.62	162.57	183.74	191.47	184.26	180.03	174.84	169.82	137.65	92.37	67.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	341.22	389.22	414.51	420.26	412.63	390.41	376.29	375.9	378.7	362.11	334.71	322.8	(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=	0.93	0.89	0.83	0.75	0.63	0.48	0.35	0.36	0.53	0.75	0.89	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.08	20.3	20.52	20.75	20.9	20.98	20.99	20.99	20.96	20.79	20.42	20.04	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.68	20.69	20.69	20.69	20.69	20.7	20.7	20.7	20.7	20.69	20.69	20.69	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.88	0.83	0.74	0.62	0.46	0.32	0.34	0.51	0.73	0.88	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.16	19.47	19.79	20.11	20.3	20.41	20.43	20.43	20.39	20.17	19.66	19.11	(90)

fLA = Living area ÷ (4) =

0.56

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.67	19.93	20.2	20.47	20.63	20.72	20.74	20.74	20.71	20.51	20.08	19.63	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.67	19.93	20.2	20.47	20.63	20.72	20.74	20.74	20.71	20.51	20.08	19.63	(93)

8. 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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.91	0.87	0.81	0.73	0.61	0.46	0.33	0.34	0.51	0.72	0.86	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	310.5	337.52	336.52	305.93	252.98	178.61	122.98	128.21	192.06	262.19	289.36	297.41	(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=	485.78	472.96	429.25	354.85	272.94	183.07	123.85	129.27	199.26	302.87	400.01	479.43	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	130.41	91.02	68.99	35.22	14.85	0	0	0	0	30.26	79.67	135.43	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 585.85 (98)

Space heating requirement in kWh/m²/year

11.72 (99)

9a. Energy requirements – 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

100 (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)

130.41	91.02	68.99	35.22	14.85	0	0	0	0	30.26	79.67	135.43

(211)m = {[(98)m x (204)] } x 100 ÷ (206)

(211)

130.41	91.02	68.99	35.22	14.85	0	0	0	0	30.26	79.67	135.43

Total (kWh/year) =Sum(211)_{1...5,10...12} = 585.85 (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)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Efficiency of water heater

349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32

Total = Sum(219a)_{1...12} = 425.57 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

585.85

Water heating fuel used

425.57

Electricity for pumps, fans and electric keep-hot

DER WorkSheet: New dwelling design stage

mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31	(231)
Electricity for lighting		238.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1345.36	(338)

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	0.519	=	304.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			524.93	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year		sum of (265)...(271) =		698.24	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.96	(273)
El rating (section 14)				90	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-03-03

Address : C-03-03, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	76	(1a) x	2.5	(2a) =	190 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			190 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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 <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>			0	(11)
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			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15	(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) =		0.13	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			5.97	x 1/[1/(1.2)+0.04]	= 6.84		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	39.05	12.19	26.86	x 0.18	= 4.83		(29)
Roof	76	0	76	x 0.14	= 10.64		(30)
Total area of elements, m²			115.05				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 29.54 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 5.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.9 (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=	17.56	17.36	17.16	16.16	15.96	14.96	14.96	14.76	15.36	15.96	16.36	16.76

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 52.46 52.26 52.06 51.06 50.86 49.86 49.86 49.66 50.26 50.86 51.26 51.66
Average = Sum(39)_{1...12} /12= 51.01 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.69	0.69	0.69	0.67	0.67	0.66	0.66	0.65	0.66	0.67	0.67	0.68		
	Average = Sum(40) _{1...12} /12=												0.67	(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

2.38

(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

90.79

(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=	99.87	96.23	92.6	88.97	85.34	81.71	81.71	85.34	88.97	92.6	96.23	99.87		
	Total = Sum(44) _{1...12} =												1089.44	(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=	148.1	129.53	133.66	116.53	111.81	96.48	89.41	102.6	103.82	120.99	132.07	143.42		
	Total = Sum(45) _{1...12} =												1428.42	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.21	19.43	20.05	17.48	16.77	14.47	13.41	15.39	15.57	18.15	19.81	21.51		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38	(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=	175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38	
Output from water heater (annual) _{1...12}												1745.76	(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=	49.24	43.07	44.44	38.75	37.18	32.08	29.73	34.11	34.52	40.23	43.91	47.69	(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=	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	20.34	18.07	14.69	11.12	8.32	7.02	7.59	9.86	13.23	16.8	19.61	20.91	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	210.88	213.07	207.55	195.81	180.99	167.07	157.76	155.57	161.09	172.83	187.65	201.57	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	(71)

Water heating gains (Table 5)

(72)m=	66.19	64.09	59.73	53.81	49.97	44.56	39.96	45.85	47.95	54.07	60.99	64.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	356.15	353.96	340.72	319.49	298.02	277.38	264.04	270.02	281.01	302.44	326.99	345.32	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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	2.13	x	10.63	x	0.4	x	0.7	=	4.39	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	8.4	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	14.27	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	30.88	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	33.06	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	30.86	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	24.49	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	17.16	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	10	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	5.42	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	3.66	(74)
South	0.9x	0.77	x	5.97	x	46.75	x	0.4	x	0.7	=	54.16	(78)
South	0.9x	0.77	x	2.13	x	46.75	x	0.4	x	0.7	=	19.32	(78)
South	0.9x	0.77	x	5.97	x	76.57	x	0.4	x	0.7	=	88.7	(78)
South	0.9x	0.77	x	2.13	x	76.57	x	0.4	x	0.7	=	31.65	(78)
South	0.9x	0.77	x	5.97	x	97.53	x	0.4	x	0.7	=	112.99	(78)
South	0.9x	0.77	x	2.13	x	97.53	x	0.4	x	0.7	=	40.31	(78)
South	0.9x	0.77	x	5.97	x	110.23	x	0.4	x	0.7	=	127.7	(78)
South	0.9x	0.77	x	2.13	x	110.23	x	0.4	x	0.7	=	45.56	(78)
South	0.9x	0.77	x	5.97	x	114.87	x	0.4	x	0.7	=	133.07	(78)
South	0.9x	0.77	x	2.13	x	114.87	x	0.4	x	0.7	=	47.48	(78)
South	0.9x	0.77	x	5.97	x	110.55	x	0.4	x	0.7	=	128.06	(78)
South	0.9x	0.77	x	2.13	x	110.55	x	0.4	x	0.7	=	45.69	(78)
South	0.9x	0.77	x	5.97	x	108.01	x	0.4	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	2.13	x	108.01	x	0.4	x	0.7	=	44.64	(78)
South	0.9x	0.77	x	5.97	x	104.89	x	0.4	x	0.7	=	121.51	(78)
South	0.9x	0.77	x	2.13	x	104.89	x	0.4	x	0.7	=	43.35	(78)
South	0.9x	0.77	x	5.97	x	101.89	x	0.4	x	0.7	=	118.03	(78)
South	0.9x	0.77	x	2.13	x	101.89	x	0.4	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	5.97	x	82.59	x	0.4	x	0.7	=	95.67	(78)
South	0.9x	0.77	x	2.13	x	82.59	x	0.4	x	0.7	=	34.13	(78)
South	0.9x	0.77	x	5.97	x	55.42	x	0.4	x	0.7	=	64.2	(78)
South	0.9x	0.77	x	2.13	x	55.42	x	0.4	x	0.7	=	22.9	(78)
South	0.9x	0.77	x	5.97	x	40.4	x	0.4	x	0.7	=	46.8	(78)
South	0.9x	0.77	x	2.13	x	40.4	x	0.4	x	0.7	=	16.7	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 77.88 128.74 167.57 196.18 211.43 206.81 200.63 189.35 177.3 139.8 92.52 67.16 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 434.02 482.7 508.29 515.67 509.44 484.19 464.67 459.38 458.3 442.24 419.51 412.48 (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=	0.96	0.94	0.91	0.85	0.76	0.61	0.46	0.48	0.67	0.85	0.94	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.72 19.92 20.18 20.5 20.76 20.93 20.98 20.98 20.89 20.57 20.1 19.68 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.65	20.66	20.66	20.66	20.67	20.67	20.67	20.67	20.67	20.67	20.66	20.66	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.91	0.85	0.74	0.58	0.43	0.45	0.65	0.84	0.93	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.89	19.27	19.73	20.08	20.31	20.36	20.36	20.26	19.84	19.17	18.56	(90)

fLA = Living area ÷ (4) =	0.4	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.05	19.3	19.64	20.04	20.35	20.56	20.61	20.61	20.51	20.13	19.55	19.01	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.05	19.3	19.64	20.04	20.35	20.56	20.61	20.61	20.51	20.13	19.55	19.01	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.94	0.92	0.89	0.83	0.73	0.57	0.42	0.44	0.64	0.83	0.92	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	409.74	444.38	450.5	426.28	371.4	277.44	195.46	203.4	291.47	364.86	384.89	392.35	(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=	773.77	752.7	683.96	568.85	440.18	297.03	200.09	209.1	322.23	484.95	637.95	765.1	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	270.84	207.19	173.7	102.65	51.17	0	0	0	0	89.35	182.2	277.33	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1354.43	(98)

Space heating requirement in kWh/m²/year

17.82	(99)

9a. Energy requirements – 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

100	(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)

270.84	207.19	173.7	102.65	51.17	0	0	0	0	89.35	182.2	277.33

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

270.84	207.19	173.7	102.65	51.17	0	0	0	0	89.35	182.2	277.33

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1354.43 \quad (211)$$

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...5,10...12} =												0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

175.05	153.87	160.61	142.61	138.76	122.57	116.36	129.55	129.9	147.95	158.16	170.38

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

50.1	44.04	45.97	40.81	39.71	35.08	33.3	37.08	37.18	42.34	45.26	48.76

Total = Sum(219a)_{1..12} =

499.63 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1354.43

Water heating fuel used

499.63

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

144.88 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

144.88 (231)

Electricity for lighting

359.27 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2358.2 (238)

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	0.519	= 702.95 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 259.31 (264)
Space and water heating	(261) + (262) + (263) + (264) =		962.26 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 75.19 (267)
Electricity for lighting	(232) x	0.519	= 186.46 (268)
Total CO2, kg/year		sum of (265)...(271) =	1223.91 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	16.1 (273)
EI rating (section 14)			86 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: C-03-04

Address : C-03-04, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	64	(1a) x	2.5	(2a) =	160 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	64	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			160 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			3.68	x 1/[1/(1.2)+0.04]	= 4.21		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 3			2.84	x 1/[1/(1.2)+0.04]	= 3.25		(27)
Walls	74.22	16.42	57.8	x 0.18	= 10.4		(29)
Roof	64	0	64	x 0.14	= 8.96		(30)
Total area of elements, m²			138.22				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 38.27 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 6.27 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.54 (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=	14.79	14.62	14.45	13.61	13.44	12.6	12.6	12.43	12.94	13.44	13.78	14.11

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.33	59.16	58.99	58.15	57.98	57.14	57.14	56.98	57.48	57.98	58.32	58.66
Average = Sum(39) _{1...12} /12=												58.11 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.93	0.92	0.92	0.91	0.91	0.89	0.89	0.89	0.9	0.91	0.91	0.92		
Average = Sum(40) _{1...12} /12=													0.91	(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

2.09

(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

83.89

(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=	92.28	88.92	85.57	82.21	78.86	75.5	75.5	78.86	82.21	85.57	88.92	92.28		
Total = Sum(44) _{1...12} =													1006.67	(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=	136.85	119.69	123.51	107.68	103.32	89.15	82.61	94.8	95.93	111.8	122.04	132.53		
Total = Sum(45) _{1...12} =													1319.91	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.53	17.95	18.53	16.15	15.5	13.37	12.39	14.22	14.39	16.77	18.31	19.88		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	163.8	144.03	150.46	133.76	130.27	115.24	109.57	121.75	122.02	138.75	148.12	159.48	(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=	163.8	144.03	150.46	133.76	130.27	115.24	109.57	121.75	122.02	138.75	148.12	159.48	
Output from water heater (annual) _{1...12}												1637.24	(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=	45.5	39.8	41.07	35.8	34.35	29.64	27.47	31.52	31.9	37.17	40.58	44.07	(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=	104.61	104.61	104.61	104.61	104.61	104.61	104.61	104.61	104.61	104.61	104.61	104.61	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.3	14.48	11.78	8.92	6.66	5.63	6.08	7.9	10.61	13.47	15.72	16.76	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	182.91	184.81	180.03	169.84	156.99	144.91	136.84	134.94	139.72	149.91	162.76	174.84	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.46	33.46	33.46	33.46	33.46	33.46	33.46	33.46	33.46	33.46	33.46	33.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.69	-83.69	-83.69	-83.69	-83.69	-83.69	-83.69	-83.69	-83.69	-83.69	-83.69	-83.69	(71)

Water heating gains (Table 5)

(72)m=	61.16	59.22	55.2	49.72	46.17	41.17	36.92	42.37	44.3	49.97	56.36	59.23	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	314.75	312.89	301.38	282.87	264.21	246.09	234.22	239.59	249.02	267.72	289.22	305.21	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c	=	Gains (W)		
North	0.9x	0.77	x	2.13	x	10.63	x	0.4	x	0.7	=	8.79	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.4	x	0.7	=	16.8	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.4	x	0.7	=	28.54	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.4	x	0.7	=	45.85	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.4	x	0.7	=	61.76	(74)

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North	0.9x	0.77	x	2.13	x	79.99	x	0.4	x	0.7	=	66.12	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.4	x	0.7	=	61.73	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.4	x	0.7	=	48.97	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.4	x	0.7	=	34.32	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.4	x	0.7	=	20	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.4	x	0.7	=	10.84	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.4	x	0.7	=	7.33	(74)
East	0.9x	0.77	x	2.84	x	19.64	x	0.4	x	0.7	=	10.82	(76)
East	0.9x	0.77	x	2.84	x	38.42	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	2.84	x	63.27	x	0.4	x	0.7	=	34.87	(76)
East	0.9x	0.77	x	2.84	x	92.28	x	0.4	x	0.7	=	50.85	(76)
East	0.9x	0.77	x	2.84	x	113.09	x	0.4	x	0.7	=	62.32	(76)
East	0.9x	0.77	x	2.84	x	115.77	x	0.4	x	0.7	=	63.8	(76)
East	0.9x	0.77	x	2.84	x	110.22	x	0.4	x	0.7	=	60.74	(76)
East	0.9x	0.77	x	2.84	x	94.68	x	0.4	x	0.7	=	52.17	(76)
East	0.9x	0.77	x	2.84	x	73.59	x	0.4	x	0.7	=	40.55	(76)
East	0.9x	0.77	x	2.84	x	45.59	x	0.4	x	0.7	=	25.12	(76)
East	0.9x	0.77	x	2.84	x	24.49	x	0.4	x	0.7	=	13.5	(76)
East	0.9x	0.77	x	2.84	x	16.15	x	0.4	x	0.7	=	8.9	(76)
West	0.9x	0.77	x	3.68	x	19.64	x	0.4	x	0.7	=	28.05	(80)
West	0.9x	0.77	x	3.68	x	38.42	x	0.4	x	0.7	=	54.87	(80)
West	0.9x	0.77	x	3.68	x	63.27	x	0.4	x	0.7	=	90.36	(80)
West	0.9x	0.77	x	3.68	x	92.28	x	0.4	x	0.7	=	131.79	(80)
West	0.9x	0.77	x	3.68	x	113.09	x	0.4	x	0.7	=	161.51	(80)
West	0.9x	0.77	x	3.68	x	115.77	x	0.4	x	0.7	=	165.34	(80)
West	0.9x	0.77	x	3.68	x	110.22	x	0.4	x	0.7	=	157.41	(80)
West	0.9x	0.77	x	3.68	x	94.68	x	0.4	x	0.7	=	135.21	(80)
West	0.9x	0.77	x	3.68	x	73.59	x	0.4	x	0.7	=	105.1	(80)
West	0.9x	0.77	x	3.68	x	45.59	x	0.4	x	0.7	=	65.11	(80)
West	0.9x	0.77	x	3.68	x	24.49	x	0.4	x	0.7	=	34.97	(80)
West	0.9x	0.77	x	3.68	x	16.15	x	0.4	x	0.7	=	23.07	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 47.66 92.84 153.77 228.49 285.59 295.25 279.87 236.36 179.97 110.23 59.31 39.29 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 362.42 405.73 455.15 511.36 549.81 541.34 514.1 475.95 428.98 377.95 348.53 344.5 (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=	0.97	0.95	0.92	0.86	0.75	0.59	0.46	0.51	0.72	0.89	0.95	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.06 19.29 19.68 20.19 20.61 20.86 20.95 20.94 20.74 20.19 19.55 19.02 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.54	20.54	20.54	20.55	20.55	20.55	20.55	20.55	20.55	20.55	20.54	20.54	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.92	0.85	0.73	0.56	0.42	0.47	0.7	0.88	0.95	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.53	17.85	18.42	19.15	19.71	20.04	20.14	20.13	19.9	19.16	18.23	17.47	(90)

fLA = Living area ÷ (4) =	0.47	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.25	18.52	19.01	19.63	20.13	20.43	20.52	20.51	20.29	19.64	18.85	18.2	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.25	18.52	19.01	19.63	20.13	20.43	20.52	20.51	20.29	19.64	18.85	18.2	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.95	0.93	0.9	0.82	0.71	0.55	0.42	0.46	0.68	0.86	0.93	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	344.61	378.33	407.55	420.16	388.59	299.57	213.85	219.82	291.44	324.87	324.93	329.54	(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=	827.39	805.96	737.96	624.26	488.72	332.95	224.03	233.94	355.73	524.34	685.1	821.14	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	359.19	287.37	245.83	146.95	74.5	0	0	0	0	148.4	259.32	365.75	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1887.32	(98)

Space heating requirement in kWh/m²/year

29.49	(99)

9a. Energy requirements – 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

100	(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)

359.19	287.37	245.83	146.95	74.5	0	0	0	0	148.4	259.32	365.75

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

359.19	287.37	245.83	146.95	74.5	0	0	0	0	148.4	259.32	365.75

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1887.32 \quad (211)$$

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...5,10...12} =												0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

163.8	144.03	150.46	133.76	130.27	115.24	109.57	121.75	122.02	138.75	148.12	159.48

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

46.88	41.22	43.06	38.28	37.28	32.98	31.36	34.85	34.92	39.71	42.39	45.64

Total = Sum(219a)_{1..12} =

468.57 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1887.32

Water heating fuel used

468.57

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

122 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

122 (231)

Electricity for lighting

287.93 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2765.82 (338)

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	0.519	=	979.52	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	243.19	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1222.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	63.32	(267)
Electricity for lighting	(232) x	0.519	=	149.43	(268)
Total CO2, kg/year		sum of (265)...(271) =		1435.46	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.43	(273)
EI rating (section 14)				82	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson **Stroma Number:** STRO006273
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: D-00-01

Address : D-00-01, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	71 (1a)	2.5 (2a)	177.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Floor			71	x 0.12	= 8.52		(28)
Walls	76.35	14.81	61.54	x 0.18	= 11.08		(29)
Total area of elements, m²			147.35				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 36.66 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 6.88 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 43.54 (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=	16.4	16.22	16.03	15.1	14.91	13.98	13.98	13.79	14.35	14.91	15.28	15.66

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.95	59.76	59.57	58.64	58.45	57.52	57.52	57.33	57.89	58.45	58.83	59.2
Average = Sum(39) _{1...12} /12=												58.59 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.84	0.84	0.84	0.83	0.82	0.81	0.81	0.81	0.82	0.82	0.83	0.83		
	Average = Sum(40) _{1...12} /12=												0.83	(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

2.27

(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

88.12

(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=	96.93	93.4	89.88	86.35	82.83	79.3	79.3	82.83	86.35	89.88	93.4	96.93		
	Total = Sum(44) _{1...12} =												1057.39	(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=	143.74	125.72	129.73	113.1	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21		
	Total = Sum(45) _{1...12} =												1386.41	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16	(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=	170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16	
Output from water heater (annual) _{1...12}												1703.74	(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=	47.79	41.8	43.13	37.61	36.08	31.14	28.85	33.11	33.51	39.05	42.62	46.29	(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=	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.16	16.13	13.12	9.93	7.42	6.27	6.77	8.8	11.81	15	17.51	18.67	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	199.62	201.69	196.47	185.36	171.33	158.15	149.34	147.27	152.49	163.6	177.63	190.81	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)

Water heating gains (Table 5)

(72)m=	64.24	62.2	57.98	52.23	48.5	43.25	38.78	44.5	46.54	52.48	59.2	62.21	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	339.07	337.08	324.62	304.57	284.31	264.71	251.95	257.63	267.89	288.14	311.39	328.74	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 48.97 95.8 157.77 230.09 281.99 288.66 274.82 236.07 183.49 113.67 61.06 40.27 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 388.04 432.88 482.38 534.66 566.29 553.38 526.76 493.69 451.38 401.81 372.45 369.01 (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=	0.97	0.96	0.93	0.86	0.75	0.59	0.46	0.5	0.72	0.89	0.96	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.24 19.46 19.82 20.29 20.66 20.89 20.96 20.95 20.78 20.29 19.69 19.2 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.58	20.58	20.58	20.59	20.59	20.59	20.59	20.6	20.59	20.59	20.59	20.58	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.92	0.85	0.73	0.57	0.42	0.46	0.69	0.88	0.95	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.83	18.14	18.67	19.34	19.84	20.14	20.22	20.21	20.01	19.35	18.49	17.78	(90)

fLA = Living area ÷ (4) =	0.57	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.63	18.88	19.32	19.88	20.31	20.56	20.64	20.63	20.45	19.89	19.17	18.59	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.88	19.32	19.88	20.31	20.56	20.64	20.63	20.45	19.89	19.17	18.59	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.9	0.83	0.72	0.56	0.42	0.47	0.68	0.86	0.94	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	370.6	405.74	434.79	443.6	406.32	311.87	223.33	230.06	307.93	347.36	348.97	354.45	(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=	858.9	835.63	763.82	643.66	502.99	342.94	232.44	242.52	367.64	542.77	710.1	851.68	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	363.3	288.89	244.79	144.04	71.92	0	0	0	0	145.38	260.02	369.94	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1888.28	(98)

Space heating requirement in kWh/m²/year

26.6	(99)

9a. Energy requirements – 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

100	(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)

363.3	288.89	244.79	144.04	71.92	0	0	0	0	145.38	260.02	369.94

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

363.3	288.89	244.79	144.04	71.92	0	0	0	0	145.38	260.02	369.94

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} =$$

1888.28	(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	0	

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} =$$

0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

48.85	42.95	44.84	39.83	38.77	34.27	32.55	36.21	36.3	41.32	44.15	47.55

Total = Sum(219a)_{1..12} =

487.61 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1888.28

Water heating fuel used

487.61

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

135.34

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

135.34 (231)

Electricity for lighting

320.72 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2831.95 (338)

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	0.519	=	980.02 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	253.07 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1233.09 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	70.24 (267)
Electricity for lighting	(232) x	0.519	=	166.45 (268)
Total CO2, kg/year		sum of (265)...(271) =		1469.78 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.7 (273)
EI rating (section 14)				83 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: D-00-02

Address : D-00-02, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x1/[1/(1.2)+ 0.04]	= 2.44		(27)
Floor			50	x 0.12	= 6		(28)
Walls	24.2	10.55	13.65	x 0.18	= 2.46		(29)
Total area of elements, m²			74.2				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 20.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 6.13 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 26.77 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 38.32 38.19 38.06 37.4 37.27 36.62 36.62 36.48 36.88 37.27 37.54 37.8 Average = Sum(39)_{1...12} /12= 37.37 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.77	0.76	0.76	0.75	0.75	0.73	0.73	0.73	0.74	0.75	0.75	0.76		
	Average = Sum(40) _{1...12} /12=												0.75	(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

1.69

(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

74.34

(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=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77		
	Total = Sum(44) _{1...12} =												892.08	(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=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44		
	Total = Sum(45) _{1...12} =												1169.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	(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=	148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39	
Output from water heater (annual) _{1...12}												1486.99	(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=	40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05	(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=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	(71)

Water heating gains (Table 5)

(72)m=	54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)

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East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	32.74	64.04	105.46	153.81	188.5	192.97	183.71	157.81	122.66	75.99	40.82	26.92	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	296.03	325.63	357.4	390.33	409.66	399.11	379.97	358.87	331.53	300.45	283.15	282.38	(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=	0.96	0.94	0.91	0.83	0.71	0.55	0.41	0.45	0.67	0.86	0.94	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.73	20.06	20.47	20.77	20.93	20.98	20.97	20.86	20.47	19.94	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.62	20.62	20.62	20.63	20.63	20.63	20.63	20.64	20.63	20.63	20.62	20.62	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.9	0.82	0.69	0.52	0.38	0.42	0.64	0.85	0.94	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.29	18.58	19.05	19.63	20.03	20.25	20.3	20.29	20.16	19.64	18.89	18.25	(90)

fLA = Living area ÷ (4) =

0.46 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.87	19.11	19.52	20.02	20.37	20.56	20.61	20.61	20.48	20.02	19.38	18.83	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.87	19.11	19.52	20.02	20.37	20.56	20.61	20.61	20.48	20.02	19.38	18.83	(93)

8. Space heating requirement

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, hm :

(94)m=	0.94	0.92	0.88	0.8	0.68	0.52	0.38	0.42	0.63	0.83	0.92	0.95	(94)

Useful gains, hmG_m , $W = (94)m \times (84)m$

(95)m=	279.07	300.34	314.96	312.42	277.55	205.76	143.76	149.08	209.36	250.38	260.39	268.06	(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 , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	558.23	542.72	495.42	415.75	323.15	218.35	146.96	153.53	235.46	351.23	460.83	552.89	(97)

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	207.69	162.88	134.26	74.4	33.93	0	0	0	0	75.03	144.31	211.92	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1044.42	(98)

Space heating requirement in $kWh/m^2/year$

20.89	(99)

9a. Energy requirements – 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 1 100 (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)

207.69	162.88	134.26	74.4	33.93	0	0	0	0	75.03	144.31	211.92

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

207.69	162.88	134.26	74.4	33.93	0	0	0	0	75.03	144.31	211.92

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1044.42 (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..5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Efficiency of water heater 349.41 (216)

(217)m = 349.41 (217)

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32	
Total = $Sum(219a)_{1..12} =$												425.57	(219)

Annual totals

Space heating fuel used, main system 1

$kWh/year$	$kWh/year$
	1044.42

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Water heating fuel used		425.57	
Electricity for pumps, fans and electric keep-hot mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31	(231)
Electricity for lighting		238.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1803.93	(338)

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	0.519	=	542.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			762.93	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year		sum of (265)...(271) =		936.24	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.72	(273)
El rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson **Stroma Number:** STRO006273
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: D-01-01

Address : D-01-01, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	71 (1a)	2.5 (2a)	177.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+ 0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+ 0.04]	= 2.44		(27)
Windows Type 3			2.13	x 1/[1/(1.2)+ 0.04]	= 2.44		(27)
Walls	76.35	14.81	61.54	x 0.18	= 11.08		(29)
Total area of elements, m²			76.35				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 28.14 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 2.77 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 30.92 (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=	16.4	16.22	16.03	15.1	14.91	13.98	13.98	13.79	14.35	14.91	15.28	15.66

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 47.32 47.13 46.95 46.01 45.83 44.89 44.89 44.71 45.27 45.83 46.2 46.57 (39)

Average = Sum(39)_{1...12} /12= 45.97 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.67	0.66	0.66	0.65	0.65	0.63	0.63	0.63	0.64	0.65	0.65	0.66		
	Average = Sum(40) _{1...12} /12=												0.65	(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

2.27

(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

88.12

(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=	96.93	93.4	89.88	86.35	82.83	79.3	79.3	82.83	86.35	89.88	93.4	96.93		
	Total = Sum(44) _{1...12} =												1057.39	(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=	143.74	125.72	129.73	113.1	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21		
	Total = Sum(45) _{1...12} =												1386.41	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16	(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=	170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16	
Output from water heater (annual) _{1...12}												1703.74	(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=	47.79	41.8	43.13	37.61	36.08	31.14	28.85	33.11	33.51	39.05	42.62	46.29	(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=	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	113.51	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.16	16.13	13.12	9.93	7.42	6.27	6.77	8.8	11.81	15	17.51	18.67	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	199.62	201.69	196.47	185.36	171.33	158.15	149.34	147.27	152.49	163.6	177.63	190.81	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	34.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)

Water heating gains (Table 5)

(72)m=	64.24	62.2	57.98	52.23	48.5	43.25	38.78	44.5	46.54	52.48	59.2	62.21	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	339.07	337.08	324.62	304.57	284.31	264.71	251.95	257.63	267.89	288.14	311.39	328.74	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)	
East	0.9x	0.77	x	6.46	x	19.64	x	0.4	x	0.7	=	24.62	(76)
East	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(76)
East	0.9x	0.77	x	6.46	x	38.42	x	0.4	x	0.7	=	48.16	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(76)
East	0.9x	0.77	x	6.46	x	63.27	x	0.4	x	0.7	=	79.31	(76)

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East	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(76)
East	0.9x	0.77	x	6.46	x	92.28	x	0.4	x	0.7	=	115.67	(76)
East	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(76)
East	0.9x	0.77	x	6.46	x	113.09	x	0.4	x	0.7	=	141.76	(76)
East	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(76)
East	0.9x	0.77	x	6.46	x	115.77	x	0.4	x	0.7	=	145.12	(76)
East	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(76)
East	0.9x	0.77	x	6.46	x	110.22	x	0.4	x	0.7	=	138.16	(76)
East	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(76)
East	0.9x	0.77	x	6.46	x	94.68	x	0.4	x	0.7	=	118.68	(76)
East	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(76)
East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
East	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(76)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	16.23	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	52.3	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	76.28	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	93.48	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	95.7	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	91.11	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	78.26	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	60.83	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	37.68	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	20.24	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	13.35	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 48.97 95.8 157.77 230.09 281.99 288.66 274.82 236.07 183.49 113.67 61.06 40.27 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 388.04 432.88 482.38 534.66 566.29 553.38 526.76 493.69 451.38 401.81 372.45 369.01 (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=	0.96	0.95	0.9	0.81	0.67	0.5	0.37	0.41	0.63	0.86	0.94	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.74 19.94 20.26 20.62 20.86 20.97 20.99 20.99 20.92 20.6 20.12 19.71 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.67	20.67	20.67	20.68	20.68	20.68	20.68	20.69	20.68	20.68	20.67	20.67	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.9	0.8	0.65	0.48	0.34	0.38	0.61	0.85	0.94	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.65	18.94	19.39	19.91	20.22	20.37	20.39	20.39	20.31	19.89	19.2	18.61	(90)

fLA = Living area ÷ (4) =	0.57	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.27	19.51	19.88	20.31	20.58	20.71	20.73	20.73	20.65	20.29	19.72	19.23	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.27	19.51	19.88	20.31	20.58	20.71	20.73	20.73	20.65	20.29	19.72	19.23	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.95	0.93	0.88	0.79	0.65	0.48	0.35	0.39	0.61	0.83	0.93	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	368.91	401.82	425.29	420.78	367.16	265.11	183.53	190.62	274	334.41	345.36	353.22	(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, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	708.36	688.51	628.25	525.23	407.06	274.16	185.54	193.59	296.62	443.96	583.07	700.21	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	252.55	192.65	151	75.2	29.69	0	0	0	0	81.51	171.15	258.16	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1211.92	(98)

Space heating requirement in kWh/m²/year

17.07	(99)

9a. Energy requirements – 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

100	(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)

252.55	192.65	151	75.2	29.69	0	0	0	0	81.51	171.15	258.16

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

252.55	192.65	151	75.2	29.69	0	0	0	0	81.51	171.15	258.16

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} =$$

1211.92	(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	0

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} =$$

0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

170.69	150.06	156.68	139.18	135.47	119.73	113.73	126.53	126.85	144.39	154.27	166.16

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

48.85	42.95	44.84	39.83	38.77	34.27	32.55	36.21	36.3	41.32	44.15	47.55

Total = Sum(219a)_{1..12} =

487.61 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1211.92

Water heating fuel used

487.61

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

135.34 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

135.34 (231)

Electricity for lighting

320.72 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2155.59 (338)

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	0.519	628.99 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	253.07 (264)
Space and water heating	(261) + (262) + (263) + (264) =		882.05 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	70.24 (267)
Electricity for lighting	(232) x	0.519	166.45 (268)
Total CO2, kg/year		sum of (265)...(271) =	1118.75 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	15.76 (273)
EI rating (section 14)			87 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: D-01-02

Address : D-01-02, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50	(1a) x	2.5	(2a) =	125 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			6.46	x 1/[1/(1.2)+0.04]	= 7.4		(27)
Windows Type 2			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Walls	24.2	10.55	13.65	x 0.18	= 2.46		(29)
Total area of elements, m²			24.2				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 14.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 1.79 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 16.44 (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=	11.55	11.42	11.29	10.63	10.5	9.84	9.84	9.71	10.11	10.5	10.76	11.03

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 27.99 27.86 27.73 27.07 26.94 26.28 26.28 26.15 26.55 26.94 27.2 27.47
Average = Sum(39)_{1...12} /12= 27.04 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.52 0.53 0.54 0.54 0.55
Average = Sum(40)_{1...12} /12= 0.54 (40)

DER WorkSheet: New dwelling design stage

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

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

1.69

(42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

74.34

(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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	
Total = Sum(44) _{1...12} =												892.08	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Total = Sum(45) _{1...12} =												1169.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.6	12.75	14.86	16.22	17.62	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

DER WorkSheet: New dwelling design stage

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=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

 (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	0

 (63)

Output from water heater

(64)m=

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Output from water heater (annual)_{1...12}

1486.99

 (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=

40.32	35.27	36.39	31.73	30.44	26.27	24.34	27.93	28.27	32.94	35.96	39.05

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

13.51	12	9.76	7.39	5.52	4.66	5.04	6.55	8.79	11.16	13.03	13.89

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45	31.45

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6	-67.6

 (71)

Water heating gains (Table 5)

(72)m=

54.2	52.48	48.91	44.06	40.92	36.49	32.72	37.54	39.26	44.28	49.94	52.49

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

263.29	261.59	251.94	236.52	221.16	206.14	196.26	201.07	208.87	224.46	242.34	255.46

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>24.62</td></tr></table>	24.62	(76)
0.77																			
6.46																			
19.64																			
0.4																			
0.7																			
24.62																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>48.16</td></tr></table>	48.16	(76)
0.77																			
6.46																			
38.42																			
0.4																			
0.7																			
48.16																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>79.31</td></tr></table>	79.31	(76)
0.77																			
6.46																			
63.27																			
0.4																			
0.7																			
79.31																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>115.67</td></tr></table>	115.67	(76)
0.77																			
6.46																			
92.28																			
0.4																			
0.7																			
115.67																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>113.09</td></tr></table>	113.09	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>141.76</td></tr></table>	141.76	(76)
0.77																			
6.46																			
113.09																			
0.4																			
0.7																			
141.76																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>115.77</td></tr></table>	115.77	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>145.12</td></tr></table>	145.12	(76)
0.77																			
6.46																			
115.77																			
0.4																			
0.7																			
145.12																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>110.22</td></tr></table>	110.22	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>138.16</td></tr></table>	138.16	(76)
0.77																			
6.46																			
110.22																			
0.4																			
0.7																			
138.16																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.46</td></tr></table>	6.46	x	<table><tr><td>94.68</td></tr></table>	94.68	x	<table><tr><td>0.4</td></tr></table>	0.4	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>118.68</td></tr></table>	118.68	(76)
0.77																			
6.46																			
94.68																			
0.4																			
0.7																			
118.68																			

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	6.46	x	73.59	x	0.4	x	0.7	=	92.24	(76)
East	0.9x	0.77	x	6.46	x	45.59	x	0.4	x	0.7	=	57.15	(76)
East	0.9x	0.77	x	6.46	x	24.49	x	0.4	x	0.7	=	30.7	(76)
East	0.9x	0.77	x	6.46	x	16.15	x	0.4	x	0.7	=	20.25	(76)
West	0.9x	0.77	x	2.13	x	19.64	x	0.4	x	0.7	=	8.12	(80)
West	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	15.88	(80)
West	0.9x	0.77	x	2.13	x	63.27	x	0.4	x	0.7	=	26.15	(80)
West	0.9x	0.77	x	2.13	x	92.28	x	0.4	x	0.7	=	38.14	(80)
West	0.9x	0.77	x	2.13	x	113.09	x	0.4	x	0.7	=	46.74	(80)
West	0.9x	0.77	x	2.13	x	115.77	x	0.4	x	0.7	=	47.85	(80)
West	0.9x	0.77	x	2.13	x	110.22	x	0.4	x	0.7	=	45.55	(80)
West	0.9x	0.77	x	2.13	x	94.68	x	0.4	x	0.7	=	39.13	(80)
West	0.9x	0.77	x	2.13	x	73.59	x	0.4	x	0.7	=	30.41	(80)
West	0.9x	0.77	x	2.13	x	45.59	x	0.4	x	0.7	=	18.84	(80)
West	0.9x	0.77	x	2.13	x	24.49	x	0.4	x	0.7	=	10.12	(80)
West	0.9x	0.77	x	2.13	x	16.15	x	0.4	x	0.7	=	6.68	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	32.74	64.04	105.46	153.81	188.5	192.97	183.71	157.81	122.66	75.99	40.82	26.92	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	296.03	325.63	357.4	390.33	409.66	399.11	379.97	358.87	331.53	300.45	283.15	282.38	(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=	0.94	0.92	0.86	0.74	0.58	0.42	0.3	0.33	0.53	0.79	0.91	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.32	20.57	20.82	20.95	20.99	21	21	20.97	20.8	20.46	20.13	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.72	20.72	20.72	20.73	20.73	20.74	20.74	20.74	20.73	20.73	20.73	20.73	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.91	0.85	0.73	0.57	0.4	0.29	0.31	0.52	0.77	0.91	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.32	19.56	19.91	20.26	20.42	20.49	20.5	20.5	20.46	20.24	19.76	19.29	(90)

fLA = Living area ÷ (4) =

0.46

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.7	19.91	20.21	20.52	20.67	20.72	20.73	20.73	20.7	20.5	20.08	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.7	19.91	20.21	20.52	20.67	20.72	20.73	20.73	20.7	20.5	20.08	19.68	(93)

8. 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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.93	0.9	0.84	0.72	0.56	0.4	0.28	0.31	0.51	0.76	0.89	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	274.78	292.44	299.13	280.44	231.45	159.28	108.23	112.79	170.32	229.67	252.71	264.54	(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=	431.18	418.26	380.22	314.54	241.53	160.87	108.5	113.2	175.19	266.7	353.14	425.08	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	116.36	84.55	60.33	24.55	7.5	0	0	0	0	27.55	72.31	119.44	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 512.6

Space heating requirement in kWh/m²/year

10.25 (99)

9a. Energy requirements – 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 1 100 (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)

116.36	84.55	60.33	24.55	7.5	0	0	0	0	27.55	72.31	119.44

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

116.36	84.55	60.33	24.55	7.5	0	0	0	0	27.55	72.31	119.44

Total (kWh/year) =Sum(211)_{1...5,10...12} = 512.6 (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	0	(215)

Total (kWh/year) =Sum(215)_{1...5,10...12} = 0

Water heating

Output from water heater (calculated above)

148.22	130.41	136.4	121.5	118.51	105.09	100.16	110.96	111.1	126.03	134.23	144.39

Efficiency of water heater 349.41 (216)

(217)m=	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	349.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	42.42	37.32	39.04	34.77	33.92	30.08	28.67	31.76	31.8	36.07	38.42	41.32	(219)

Total = Sum(219a)_{1...12} = 425.57

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1 512.6

Water heating fuel used 425.57

Electricity for pumps, fans and electric keep-hot

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mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	95.31	(231)
Electricity for lighting		238.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1272.11	(338)

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	0.519	=	266.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	220.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			486.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	49.47	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year		sum of (265)...(271) =		660.22	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.2	(273)
El rating (section 14)				91	(274)

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User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: D-03-01

Address : D-03-01, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	54	(1a) x	2.5	(2a) =	135 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			135 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.14 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			2.84	x1/[1/(1.2)+ 0.04]	= 3.25		(27)
Windows Type 2			2.84	x1/[1/(1.2)+ 0.04]	= 3.25		(27)
Windows Type 3			2.84	x1/[1/(1.2)+ 0.04]	= 3.25		(27)
Walls	51.9	16.16	35.74	x 0.18	= 6.43		(29)
Roof	54	0	54	x 0.14	= 7.56		(30)
Total area of elements, m²			105.9				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 32.6 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 5.15 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 37.75 (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=	13.12	12.96	12.81	12.03	11.88	11.11	11.11	10.95	11.42	11.88	12.19	12.5

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	50.87	50.71	50.56	49.79	49.63	48.86	48.86	48.7	49.17	49.63	49.94	50.25
Average = Sum(39) _{1...12} /12=												49.75 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.94	0.94	0.94	0.92	0.92	0.9	0.9	0.9	0.91	0.92	0.92	0.93		
Average = Sum(40) _{1...12} /12=													0.92	(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

1.81

(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

77.14

(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=	84.85	81.77	78.68	75.6	72.51	69.43	69.43	72.51	75.6	78.68	81.77	84.85		
Total = Sum(44) _{1...12} =													925.68	(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=	125.84	110.06	113.57	99.01	95	81.98	75.97	87.17	88.22	102.81	112.22	121.87		
Total = Sum(45) _{1...12} =													1213.71	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.88	16.51	17.04	14.85	14.25	12.3	11.4	13.08	13.23	15.42	16.83	18.28		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	152.79	134.4	140.52	125.09	121.96	108.06	102.92	114.13	114.3	129.76	138.3	148.82	(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=	152.79	134.4	140.52	125.09	121.96	108.06	102.92	114.13	114.3	129.76	138.3	148.82	
Output from water heater (annual) _{1...12}												1531.04	(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=	41.84	36.59	37.76	32.92	31.59	27.26	25.26	28.99	29.33	34.18	37.31	40.52	(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=	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.05	12.48	10.15	7.68	5.74	4.85	5.24	6.81	9.14	11.61	13.55	14.44	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	157.6	159.24	155.12	146.35	135.27	124.86	117.91	116.27	120.39	129.17	140.24	150.65	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	(71)

Water heating gains (Table 5)

(72)m=	56.24	54.46	50.75	45.72	42.46	37.86	33.95	38.96	40.74	45.95	51.82	54.46	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	278.01	276.3	266.14	249.87	233.59	217.69	207.22	212.16	220.39	236.84	255.73	269.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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	2.84	x	10.63	x	0.4	x	0.7	=	11.72	(74)
North	0.9x	0.77	x	2.84	x	20.32	x	0.4	x	0.7	=	22.4	(74)
North	0.9x	0.77	x	2.84	x	34.53	x	0.4	x	0.7	=	38.06	(74)
North	0.9x	0.77	x	2.84	x	55.46	x	0.4	x	0.7	=	61.13	(74)
North	0.9x	0.77	x	2.84	x	74.72	x	0.4	x	0.7	=	82.35	(74)

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North	0.9x	0.77	x	2.84	x	79.99	x	0.4	x	0.7	=	88.16	(74)
North	0.9x	0.77	x	2.84	x	74.68	x	0.4	x	0.7	=	82.3	(74)
North	0.9x	0.77	x	2.84	x	59.25	x	0.4	x	0.7	=	65.3	(74)
North	0.9x	0.77	x	2.84	x	41.52	x	0.4	x	0.7	=	45.76	(74)
North	0.9x	0.77	x	2.84	x	24.19	x	0.4	x	0.7	=	26.66	(74)
North	0.9x	0.77	x	2.84	x	13.12	x	0.4	x	0.7	=	14.46	(74)
North	0.9x	0.77	x	2.84	x	8.86	x	0.4	x	0.7	=	9.77	(74)
East	0.9x	0.77	x	2.84	x	19.64	x	0.4	x	0.7	=	10.82	(76)
East	0.9x	0.77	x	2.84	x	38.42	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	2.84	x	63.27	x	0.4	x	0.7	=	34.87	(76)
East	0.9x	0.77	x	2.84	x	92.28	x	0.4	x	0.7	=	50.85	(76)
East	0.9x	0.77	x	2.84	x	113.09	x	0.4	x	0.7	=	62.32	(76)
East	0.9x	0.77	x	2.84	x	115.77	x	0.4	x	0.7	=	63.8	(76)
East	0.9x	0.77	x	2.84	x	110.22	x	0.4	x	0.7	=	60.74	(76)
East	0.9x	0.77	x	2.84	x	94.68	x	0.4	x	0.7	=	52.17	(76)
East	0.9x	0.77	x	2.84	x	73.59	x	0.4	x	0.7	=	40.55	(76)
East	0.9x	0.77	x	2.84	x	45.59	x	0.4	x	0.7	=	25.12	(76)
East	0.9x	0.77	x	2.84	x	24.49	x	0.4	x	0.7	=	13.5	(76)
East	0.9x	0.77	x	2.84	x	16.15	x	0.4	x	0.7	=	8.9	(76)
West	0.9x	0.77	x	2.84	x	19.64	x	0.4	x	0.7	=	21.65	(80)
West	0.9x	0.77	x	2.84	x	38.42	x	0.4	x	0.7	=	42.35	(80)
West	0.9x	0.77	x	2.84	x	63.27	x	0.4	x	0.7	=	69.74	(80)
West	0.9x	0.77	x	2.84	x	92.28	x	0.4	x	0.7	=	101.71	(80)
West	0.9x	0.77	x	2.84	x	113.09	x	0.4	x	0.7	=	124.64	(80)
West	0.9x	0.77	x	2.84	x	115.77	x	0.4	x	0.7	=	127.6	(80)
West	0.9x	0.77	x	2.84	x	110.22	x	0.4	x	0.7	=	121.48	(80)
West	0.9x	0.77	x	2.84	x	94.68	x	0.4	x	0.7	=	104.35	(80)
West	0.9x	0.77	x	2.84	x	73.59	x	0.4	x	0.7	=	81.11	(80)
West	0.9x	0.77	x	2.84	x	45.59	x	0.4	x	0.7	=	50.25	(80)
West	0.9x	0.77	x	2.84	x	24.49	x	0.4	x	0.7	=	26.99	(80)
West	0.9x	0.77	x	2.84	x	16.15	x	0.4	x	0.7	=	17.8	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 44.19 85.91 142.66 213.69 269.31 279.55 264.52 221.82 167.42 102.03 54.94 36.47 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 322.2 362.21 408.81 463.56 502.91 497.24 471.74 433.98 387.81 338.87 310.68 306.15 (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=	0.96	0.95	0.91	0.84	0.72	0.56	0.43	0.48	0.7	0.88	0.95	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.08 19.31 19.72 20.23 20.64 20.88 20.96 20.94 20.76 20.22 19.57 19.04 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.53	20.53	20.53	20.54	20.54	20.55	20.55	20.55	20.54	20.54	20.54	20.53	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.91	0.83	0.7	0.53	0.39	0.44	0.67	0.87	0.94	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.54	17.88	18.46	19.19	19.74	20.05	20.14	20.12	19.91	19.19	18.26	17.49	(90)

fLA = Living area ÷ (4) =	0.48	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.28	18.56	19.06	19.69	20.17	20.45	20.53	20.52	20.31	19.68	18.88	18.23	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.28	18.56	19.06	19.69	20.17	20.45	20.53	20.52	20.31	19.68	18.88	18.23	(93)

8. 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

Utilisation factor for gains, hm:

(94)m=	0.95	0.92	0.88	0.8	0.68	0.52	0.39	0.44	0.66	0.85	0.92	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	304.59	334.99	361.33	372.17	342.05	260.52	184.41	189.79	254.61	286.67	287.31	291.31	(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=	710.89	692.88	634.95	537.19	420.37	285.64	191.97	200.46	305.47	450.69	588.44	704.97	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	302.29	240.5	203.58	118.81	58.27	0	0	0	0	122.03	216.81	307.76	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1570.05	(98)

Space heating requirement in kWh/m²/year

29.07	(99)

9a. Energy requirements – 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

100	(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)

302.29	240.5	203.58	118.81	58.27	0	0	0	0	122.03	216.81	307.76

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

302.29	240.5	203.58	118.81	58.27	0	0	0	0	122.03	216.81	307.76

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} =$$

1570.05	(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	0	

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} =$$

0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

152.79	134.4	140.52	125.09	121.96	108.06	102.92	114.13	114.3	129.76	138.3	148.82

Efficiency of water heater

349.41 (216)

(217)m= 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 349.41 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

43.73	38.46	40.22	35.8	34.9	30.93	29.46	32.66	32.71	37.14	39.58	42.59

Total = Sum(219a)_{1..12} =

438.18 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1570.05

Water heating fuel used

438.18

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

102.94

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

102.94

(231)

Electricity for lighting

248.14

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

2359.3

(238)

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	0.519	=	814.86	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	227.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1042.27	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	53.42	(267)
Electricity for lighting	(232) x	0.519	=	128.78	(268)
Total CO2, kg/year		sum of (265)...(271) =		1224.48	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.68	(273)
EI rating (section 14)				83	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: John Simpson

Stroma Number:

STRO006273

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: D-03-02

Address : D-03-02, Block C, The Roundway, London

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	54	(1a) x	2.5	(2a) =	135 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			135 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	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 <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>			0 (11)
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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (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 (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 0 0 0 0 0 0 0 0 0 0 0 (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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.28 0.28 0.27 0.26 0.25 0.24 0.24 0.24 0.24 0.25 0.26 0.27 (25)

3. Heat losses and heat loss 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			1.96	x 1.2	= 2.352		(26)
Windows Type 1			2.84	x 1/[1/(1.2)+0.04]	= 3.25		(27)
Windows Type 2			2.84	x 1/[1/(1.2)+0.04]	= 3.25		(27)
Walls	26.15	10.48	15.67	x 0.18	= 2.82		(29)
Roof	54	0	54	x 0.14	= 7.56		(30)
Total area of elements, m²			80.15				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 22.49 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 4.33 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 26.82 (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=	12.48	12.33	12.19	11.48	11.34	10.63	10.63	10.49	10.91	11.34	11.62	11.91

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 39.3 39.15 39.01 38.3 38.16 37.45 37.45 37.31 37.73 38.16 38.44 38.73
Average = Sum(39)_{1...12} /12= 38.27 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.73	0.73	0.72	0.71	0.71	0.69	0.69	0.69	0.7	0.71	0.71	0.72		
Average = Sum(40) _{1...12} /12=													0.71	(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

1.81

(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

77.14

(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=	84.85	81.77	78.68	75.6	72.51	69.43	69.43	72.51	75.6	78.68	81.77	84.85		
Total = Sum(44) _{1...12} =													925.68	(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=	125.84	110.06	113.57	99.01	95	81.98	75.97	87.17	88.22	102.81	112.22	121.87		
Total = Sum(45) _{1...12} =													1213.71	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.88	16.51	17.04	14.85	14.25	12.3	11.4	13.08	13.23	15.42	16.83	18.28		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

201

(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):

0.54

(48)

Temperature factor from Table 2b

0.8694

(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)

0.87

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	26.95	24.34	26.95	26.08	26.95	26.08	26.95	26.95	26.08	26.95	26.08	26.95		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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	0		(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	152.79	134.4	140.52	125.09	121.96	108.06	102.92	114.13	114.3	129.76	138.3	148.82	(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=	152.79	134.4	140.52	125.09	121.96	108.06	102.92	114.13	114.3	129.76	138.3	148.82	
Output from water heater (annual) _{1...12}												1531.04	(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=	41.84	36.59	37.76	32.92	31.59	27.26	25.26	28.99	29.33	34.18	37.31	40.52	(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=	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.7	13.06	10.62	8.04	6.01	5.07	5.48	7.12	9.56	12.14	14.17	15.11	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	157.6	159.24	155.12	146.35	135.27	124.86	117.91	116.27	120.39	129.17	140.24	150.65	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	32.04	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	-72.32	(71)

Water heating gains (Table 5)

(72)m=	56.24	54.46	50.75	45.72	42.46	37.86	33.95	38.96	40.74	45.95	51.82	54.46	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	278.66	276.87	266.61	250.23	233.86	217.91	207.46	212.48	220.81	237.37	256.36	270.34	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.84	x	19.64	x	0.4	x	0.7	=	10.82	(76)
East	0.9x	0.77	x	2.84	x	38.42	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	2.84	x	63.27	x	0.4	x	0.7	=	34.87	(76)
East	0.9x	0.77	x	2.84	x	92.28	x	0.4	x	0.7	=	50.85	(76)
East	0.9x	0.77	x	2.84	x	113.09	x	0.4	x	0.7	=	62.32	(76)

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East	0.9x	0.77	x	2.84	x	115.77	x	0.4	x	0.7	=	63.8	(76)
East	0.9x	0.77	x	2.84	x	110.22	x	0.4	x	0.7	=	60.74	(76)
East	0.9x	0.77	x	2.84	x	94.68	x	0.4	x	0.7	=	52.17	(76)
East	0.9x	0.77	x	2.84	x	73.59	x	0.4	x	0.7	=	40.55	(76)
East	0.9x	0.77	x	2.84	x	45.59	x	0.4	x	0.7	=	25.12	(76)
East	0.9x	0.77	x	2.84	x	24.49	x	0.4	x	0.7	=	13.5	(76)
East	0.9x	0.77	x	2.84	x	16.15	x	0.4	x	0.7	=	8.9	(76)
West	0.9x	0.77	x	2.84	x	19.64	x	0.4	x	0.7	=	21.65	(80)
West	0.9x	0.77	x	2.84	x	38.42	x	0.4	x	0.7	=	42.35	(80)
West	0.9x	0.77	x	2.84	x	63.27	x	0.4	x	0.7	=	69.74	(80)
West	0.9x	0.77	x	2.84	x	92.28	x	0.4	x	0.7	=	101.71	(80)
West	0.9x	0.77	x	2.84	x	113.09	x	0.4	x	0.7	=	124.64	(80)
West	0.9x	0.77	x	2.84	x	115.77	x	0.4	x	0.7	=	127.6	(80)
West	0.9x	0.77	x	2.84	x	110.22	x	0.4	x	0.7	=	121.48	(80)
West	0.9x	0.77	x	2.84	x	94.68	x	0.4	x	0.7	=	104.35	(80)
West	0.9x	0.77	x	2.84	x	73.59	x	0.4	x	0.7	=	81.11	(80)
West	0.9x	0.77	x	2.84	x	45.59	x	0.4	x	0.7	=	50.25	(80)
West	0.9x	0.77	x	2.84	x	24.49	x	0.4	x	0.7	=	26.99	(80)
West	0.9x	0.77	x	2.84	x	16.15	x	0.4	x	0.7	=	17.8	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=

32.47	63.52	104.6	152.56	186.97	191.39	182.22	156.52	121.66	75.37	40.49	26.7

 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=

311.13	340.39	371.22	402.79	420.82	409.31	389.67	369	342.47	312.74	296.84	297.04

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.96	0.95	0.91	0.83	0.71	0.55	0.41	0.45	0.67	0.87	0.94	0.97

 (86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=

19.62	19.8	20.12	20.5	20.78	20.94	20.98	20.98	20.88	20.51	20.01	19.58

 (87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=

20.64	20.64	20.64	20.65	20.65	20.65	20.65	20.65	20.65	20.65	20.64	20.64

 (88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=

0.96	0.94	0.9	0.82	0.7	0.52	0.38	0.42	0.64	0.86	0.94	0.96

 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=

18.43	18.7	19.15	19.7	20.09	20.29	20.33	20.33	20.21	19.72	19.01	18.39

 (90)

fLA = Living area ÷ (4) =

0.48

 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=

19	19.23	19.61	20.09	20.42	20.6	20.64	20.64	20.53	20.1	19.49	18.96

 (92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19	19.23	19.61	20.09	20.42	20.6	20.64	20.64	20.53	20.1	19.49	18.96	(93)

8. Space heating requirement

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=	0.95	0.93	0.89	0.81	0.68	0.52	0.38	0.42	0.63	0.84	0.92	0.95	(94)

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	294.09	315.13	328.95	324.9	287.8	212.75	148.55	154.11	217.42	261.85	273.84	282.66	(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 , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	577.59	561.03	511.56	428.45	332.74	224.69	151.47	158.19	242.57	362.41	476.18	571.76	(97)

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	210.92	165.25	135.86	74.56	33.44	0	0	0	0	74.82	145.68	215.09	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1055.61	(98)

Space heating requirement in $kWh/m^2/year$

19.55	(99)

9a. Energy requirements – 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 1 100 (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)

210.92	165.25	135.86	74.56	33.44	0	0	0	0	74.82	145.68	215.09

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

210.92	165.25	135.86	74.56	33.44	0	0	0	0	74.82	145.68	215.09

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1055.61 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$												0	(215)

Water heating

Output from water heater (calculated above)

152.79	134.4	140.52	125.09	121.96	108.06	102.92	114.13	114.3	129.76	138.3	148.82

Efficiency of water heater 349.41 (216)

(217)m = 349.41 (217)

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	43.73	38.46	40.22	35.8	34.9	30.93	29.46	32.66	32.71	37.14	39.58	42.59	
Total = $Sum(219a)_{1..12} =$												438.18	(219)

Annual totals

Space heating fuel used, main system 1

$kWh/year$	$kWh/year$
	1055.61

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Water heating fuel used		438.18	
Electricity for pumps, fans and electric keep-hot mechanical ventilation - balanced, extract or positive input from outside		102.94	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	102.94	(231)
Electricity for lighting		259.6	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1856.32	(338)

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	0.519	=	547.86	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	227.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =			775.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	53.42	(267)
Electricity for lighting	(232) x	0.519	=	134.73	(268)
Total CO2, kg/year		sum of (265)...(271) =		963.43	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.84	(273)
EI rating (section 14)				87	(274)