

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-01-01

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

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	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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.55	13.12	14.49	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	
Output from water heater (annual) _{1...12}												1405.94	(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=	46.23	40.53	42.07	37.01	35.77	31.23	29.31	33.11	33.35	38.42	41.5	44.89	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	62.14	60.32	56.54	51.41	48.07	43.38	39.4	44.51	46.32	51.64	57.64	60.33	(72)

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

(73)m=	293.41	291.65	281.21	264.47	247.7	231.33	220.57	225.61	234.09	251.01	270.45	284.82	(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)

DER WorkSheet: New dwelling design stage

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)

DER WorkSheet: New dwelling design stage

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=	424.42	515.62	588.67	645.32	672.87	652.47	627.02	599.37	567.15	498.92	427.55	396.82	(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	0.89	0.83	0.74	0.61	0.46	0.34	0.37	0.55	0.77	0.9	0.95	(86)

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

(87)m=	19.37	19.71	20.1	20.5	20.78	20.93	20.98	20.97	20.88	20.5	19.87	19.3	(87)

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

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.16	20.15	(88)

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

(89)m=	0.93	0.88	0.81	0.71	0.57	0.41	0.28	0.31	0.5	0.74	0.89	0.94	(89)

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

(90)m=	17.96	18.44	19	19.56	19.92	20.11	20.16	20.15	20.05	19.57	18.69	17.88	(90)

fLA = Living area ÷ (4) =

0.64

 (91)

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

(92)m=	18.86	19.25	19.7	20.16	20.47	20.63	20.68	20.68	20.58	20.16	19.44	18.79	(92)

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

(93)m=	18.71	19.1	19.55	20.01	20.32	20.48	20.53	20.53	20.43	20.01	19.29	18.64	(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	0.8	0.7	0.58	0.43	0.31	0.34	0.52	0.74	0.87	0.92	(94)

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

(95)m=	387.04	445.78	470.44	452.54	387.81	280.2	193.16	201.09	292.39	367.58	372.68	366.46	(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=	749.96	736.77	675.26	566.69	438.26	294.91	197.07	206.24	319.01	478.85	623.67	742.75	(97)

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

(98)m=	270.01	195.55	152.39	82.19	37.54	0	0	0	0	82.78	180.71	279.96

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

1281.14

 (98)

Space heating requirement in kWh/m ² /year	22.88	(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	430.94	350.97	356.16	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	825.99	795.13	763.56	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	284.44	330.45	303.1	0	0	0	0	
										Total = Sum(104) =		917.99	(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	44.44	51.63	47.36	0	0	0	0	
										Total = Sum(107) =		143.44	(107)
Space cooling requirement in kWh/m²/year										(107) ÷ (4) =		2.56	(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		92.9	(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)													
	270.01	195.55	152.39	82.19	37.54	0	0	0	0	82.78	180.71	279.96	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	290.65	210.49	164.04	88.47	40.41	0	0	0	0	89.11	194.52	301.36	
										Total (kWh/year) = Sum(211) _{1...5,10...12} =		1379.05	(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)

142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6

Efficiency of water heater

	87.3											(216)	
(217)m=	89.37	89.22	89	88.61	88.09	87.3	87.3	87.3	87.3	88.58	89.14	89.41	(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.63	140.28	146.2	129.55	126.18	111.56	105.06	118.17	118.87	134.48	143.91	155.01	
Total = Sum(219a) _{1...12} =													1588.91 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	10.29	11.95	10.96	0	0	0	0	
Total = Sum(221) _{6...8} =													33.2 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

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

kWh/year

kWh/year

106.75	(230a)
30	(230c)
45	(230e)

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

1379.05	
1588.91	
33.2	
181.75	(231)
256.25	(232)
3439.16	(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	0.216 =	297.87 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	343.2 (264)
Space and water heating	(261) + (262) + (263) + (264) =		641.08 (265)
Space cooling	(221) x	0.519 =	17.23 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	94.33 (267)
Electricity for lighting	(232) x	0.519 =	132.99 (268)
Total CO2, kg/year		sum of (265)...(271) =	885.63 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	15.81 (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: 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

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			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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.85	269.18	259.56	244.19	228.87	213.87	203.96	208.75	216.5	232.04	249.89	263.01	(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)

DER WorkSheet: New dwelling design stage

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= 309.8 345.37 385.04 427.19 453.14 443.45 422.54 396.5 362.44 322.45 298.46 295.04 (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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.95	0.93	0.89	0.8	0.66	0.5	0.37	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 19.82 20.16 20.55 20.82 20.95 20.99 20.98 20.89 20.53 20.01 19.57 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.29	20.29	20.29	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.3	20.3	(88)

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

(89)m=	0.95	0.93	0.88	0.77	0.62	0.45	0.31	0.35	0.57	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=	18.4	18.71	19.19	19.75	20.1	20.27	20.31	20.31	20.2	19.73	19	18.36	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.95	19.21	19.63	20.11	20.43	20.58	20.62	20.61	20.52	20.1	19.46	18.91	(92)

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

(93)m=	18.8	19.06	19.48	19.96	20.28	20.43	20.47	20.46	20.37	19.95	19.31	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=	0.93	0.91	0.86	0.76	0.62	0.46	0.33	0.36	0.58	0.8	0.91	0.94	(94)

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

(95)m=	289.41	313.82	330.29	324.99	282.41	202.83	138.08	143.82	209.58	258.99	270.48	277.84	(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=	549.3	534.66	488.32	408.97	315.92	210.97	139.92	146.49	228.33	344.26	452.87	543.86	(97)

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

(98)m=	193.36	148.41	117.57	60.47	24.94	0	0	0	0	63.44	131.32	197.92	(98)

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	937.42	(98)

Space heating requirement in kWh/m²/year

18.75	(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	316.58	256.73	260.08	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	575.77	550.35	520.57	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	186.62	218.45	193.8	0	0	0	0	(104)

Total = Sum(104) =	598.87	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	32.66	38.23	33.91	0	0	0	0		
	Total = Sum(107) =												104.8	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =												2.1	(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		92.9	(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)

193.36	148.41	117.57	60.47	24.94	0	0	0	0	63.44	131.32	197.92

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

208.14	159.75	126.56	65.09	26.84	0	0	0	0	68.29	141.36	213.04

Total (kWh/year) =Sum(211) _{1...5,10...12} =	1009.07	(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)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater	87.3	(216)

(217)m=	89.15	89.05	88.83	88.41	87.89	87.3	87.3	87.3	87.3	88.42	88.93	89.19	(217)

Fuel for water heating, kWh/month

$$(219)_m = (64)_m \times 100 \div (217)_m$$

(219)m=	152.3	133.81	139.5	123.72	120.56	106.44	100.31	112.72	113.35	128.38	137.37	147.94		
Total = Sum(219a) _{1...12} =													1516.41	(219)

Space cooling fuel, kWh/month.

$$(221)_m = (107)_m \div (209)$$

(221)m=	0	0	0	0	0	7.56	8.85	7.85	0	0	0	0		
Total = Sum(221) _{6..8} =													24.26	(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	95.31	(230a)

central heating pump: 30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		232.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2953	(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	0.216	=	217.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	327.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =			545.5	(265)
Space cooling	(221) x	0.519	=	12.59	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Total CO2, kg/year		sum of (265)...(271) =		767.39	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.35	(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: 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

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)
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)

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	0.72	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)

(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

2.65

(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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.69	13.26	14.64	14.11	14.54	14.03	14.47	14.52	14.08	14.6	14.18	14.68	(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=	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21	(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=	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21	
Output from water heater (annual) _{1...12}												1700.95	(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=	56.39	49.42	51.24	45.01	43.43	37.85	35.44	40.15	40.47	46.72	50.56	54.72	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	75.79	73.54	68.87	62.51	58.38	52.57	47.64	53.96	56.21	62.79	70.22	73.55	(72)

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

(73)m=	406.58	404.36	389.64	365.86	341.59	318.33	303.31	309.61	321.91	345.91	373.47	394.25	(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	=	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 $0.9 \times \boxed{0.77} \times \boxed{6.46} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.7} = \boxed{20.25}$ (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=

461.42	511.36	566.43	626.51	664.75	651.08	619.28	578.33	528.28	472.92	441.76	439.41

 (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	0.87	0.75	0.58	0.44	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=

19.46	19.65	19.99	20.42	20.74	20.93	20.98	20.97	20.84	20.41	19.87	19.43

 (87)

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

(88)m=

20.31	20.31	20.31	20.33	20.33	20.34	20.34	20.34	20.34	20.33	20.32	20.32

 (88)

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

(89)m=

0.97	0.96	0.92	0.85	0.72	0.53	0.38	0.43	0.67	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=

18.2	18.49	18.97	19.58	20.03	20.27	20.32	20.32	20.16	19.59	18.81	18.17

 (90)

fLA = Living area ÷ (4) =

0.33

 (91)

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

(92)m=

18.62	18.88	19.31	19.86	20.26	20.49	20.54	20.54	20.39	19.86	19.16	18.59

 (92)

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

(93)m=

18.47	18.73	19.16	19.71	20.11	20.34	20.39	20.39	20.24	19.71	19.01	18.44

 (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	0.53	0.39	0.43	0.66	0.86	0.94	0.96

 (94)

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

(95)m=

442.44	481.6	512.98	519.49	468.68	347.81	239.38	248.53	350.22	408.49	415.39	423.67

 (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=

958.03	931.31	849.69	712.52	552.49	369.72	244.45	255.96	398.68	598.3	788.07	948.64

 (97)

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

(98)m=

383.6	302.21	250.51	138.98	62.36	0	0	0	0	141.22	268.33	390.58

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

1937.78

 (98)

Space heating requirement in kWh/m²/year

21.06

 (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	605.88	476.97	488.02	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	542.68	446.36	449.51	0	0	0	0	(102)	
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	854.33	815.36	768.93	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	224.39	274.53	237.65	0	0	0	0		
									Total = Sum(104) =		736.57		(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	21.34	26.11	22.6	0	0	0	0		
									Total = Sum(107) =		70.05		(107)	
Space cooling requirement in kWh/m²/year										(107) ÷ (4) =		0.76		(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		92.9	(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)	383.6	302.21	250.51	138.98	62.36	0	0	0	0	141.22	268.33	390.58		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														
	412.91	325.3	269.66	149.6	67.13	0	0	0	0	152.01	288.84	420.43		
												Total (kWh/year) = Sum(211) _{1...5,10...12} =	2085.88	(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)														
	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21		
Efficiency of water heater													87.3	(216)
(217)m=	89.48	89.4	89.24	88.87	88.29	87.3	87.3	87.3	87.3	88.85	89.3	89.51	(217)	

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	193.6	169.92	176.75	156.25	152.04	134.38	126.21	142.44	143.43	162.21	174.21	187.92	
Total = Sum(219a) _{1...12} =													1919.37 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	4.94	6.04	5.23	0	0	0	0	
Total = Sum(221) _{6...8} =													16.22 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

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

Electricity for lighting

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	0.216 =	450.55 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	414.58 (264)
Space and water heating	(261) + (262) + (263) + (264) =		865.13 (265)
Space cooling	(221) x	0.519 =	8.42 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	135.41 (267)
Electricity for lighting	(232) x	0.519 =	204.43 (268)
Total CO2, kg/year		sum of (265)...(271) =	1213.38 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.19 (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: 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

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	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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.55	13.12	14.49	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	
Output from water heater (annual) _{1...12}												1405.94	(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=	46.23	40.53	42.07	37.01	35.77	31.23	29.31	33.11	33.35	38.42	41.5	44.89	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	62.14	60.32	56.54	51.41	48.07	43.38	39.4	44.51	46.32	51.64	57.64	60.33	(72)

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

(73)m=	293.41	291.65	281.21	264.47	247.7	231.33	220.57	225.61	234.09	251.01	270.45	284.82	(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	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)

DER WorkSheet: New dwelling design stage

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)

DER WorkSheet: New dwelling design stage

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=	424.42	515.62	588.67	645.32	672.87	652.47	627.02	599.37	567.15	498.92	427.55	396.82	(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	0.88	0.81	0.7	0.57	0.42	0.31	0.33	0.51	0.74	0.89	0.94	(86)

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

(87)m=	19.63	19.96	20.31	20.65	20.86	20.96	20.99	20.99	20.93	20.64	20.09	19.57	(87)

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

(88)m=	20.23	20.23	20.23	20.24	20.25	20.26	20.26	20.26	20.25	20.25	20.24	20.24	(88)

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

(89)m=	0.92	0.87	0.79	0.67	0.53	0.38	0.26	0.28	0.46	0.71	0.88	0.93	(89)

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

(90)m=	18.4	18.85	19.35	19.82	20.09	20.22	20.25	20.25	20.18	19.82	19.06	18.31	(90)

fLA = Living area ÷ (4) =

0.64	(91)

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

(92)m=	19.18	19.56	19.96	20.35	20.58	20.69	20.72	20.72	20.66	20.34	19.71	19.11	(92)

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

(93)m=	19.03	19.41	19.81	20.2	20.43	20.54	20.57	20.57	20.51	20.19	19.56	18.96	(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	0.85	0.78	0.67	0.54	0.39	0.28	0.3	0.48	0.71	0.86	0.92	(94)

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

(95)m=	384.77	440.14	459.51	433.94	363.67	256.69	174.96	182.48	271.43	354.8	368.22	364.76	(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=	684.29	671.54	614.31	513.1	395.17	264.65	176.84	185.03	287.12	434.17	567.77	676.91	(97)

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

(98)m=	222.84	155.5	115.17	57	23.44	0	0	0	0	59.05	143.68	232.24

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

1008.93	(98)

Space heating requirement in kWh/m²/year

18.02	(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	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	395.87	318.98	324.59	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	825.99	795.13	763.56	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	309.69	354.25	326.59	0	0	0	0	
									Total = Sum(104) =		990.53		(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 × (105) × (106)m													
(107)m=	0	0	0	0	0	48.39	55.35	51.03	0	0	0	0	
									Total = Sum(107) =		154.77		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		2.76		(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

92.9

(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)

222.84	155.5	115.17	57	23.44	0	0	0	0	59.05	143.68	232.24

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

(211)

239.88	167.39	123.97	61.35	25.23	0	0	0	0	63.57	154.66	249.99

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

1086.03

(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)

142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6

Efficiency of water heater

87.3

(216)

(217)m=

89.22	89.04	88.77	88.34	87.84	87.3	87.3	87.3	87.3	88.34	88.96	89.28

(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.88	140.56	146.57	129.95	126.54	111.56	105.06	118.17	118.87	134.86	144.21	155.25	
Total = Sum(219a) _{1...12} =													1591.48 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	11.2	12.81	11.81	0	0	0	0	
Total = Sum(221) _{6...8} =													35.83 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

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

106.75	(230a)
30	(230c)
45	(230e)
sum of (230a)...(230g) =	181.75 (231)
256.25	(232)
3151.34	(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	0.216 =	234.58 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	343.76 (264)
Space and water heating	(261) + (262) + (263) + (264) =		578.34 (265)
Space cooling	(221) x	0.519 =	18.59 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	94.33 (267)
Electricity for lighting	(232) x	0.519 =	132.99 (268)
Total CO2, kg/year	sum of (265)...(271) =		824.26 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =		14.72 (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: 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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.85	269.18	259.56	244.19	228.87	213.87	203.96	208.75	216.5	232.04	249.89	263.01	(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)

DER WorkSheet: New dwelling design stage

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=

309.8	345.37	385.04	427.19	453.14	443.45	422.54	396.5	362.44	322.45	298.46	295.04

 (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
0.95	0.92	0.87	0.75	0.6	0.44	0.32	0.36	0.56	0.81	0.92	0.95

 (86)

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

(87)m=

19.9	20.1	20.4	20.72	20.9	20.98	21	20.99	20.95	20.69	20.25	19.87

 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.38	20.38	20.38	20.39	20.4	20.41	20.41	20.41	20.4	20.4	20.39	20.39	(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	0.28	0.31	0.52	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=	18.88	19.17	19.59	20.05	20.29	20.39	20.41	20.41	20.35	20.02	19.41	18.84	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	19.34	19.59	19.96	20.35	20.57	20.66	20.67	20.67	20.62	20.32	19.79	19.31	(92)

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

(93)m=	19.19	19.44	19.81	20.2	20.42	20.51	20.52	20.52	20.47	20.17	19.64	19.16	(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	0.84	0.72	0.57	0.41	0.29	0.32	0.53	0.77	0.89	0.94	(94)

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

(95)m=	287.52	310.16	322.69	309.46	260.12	180.84	121.68	127.02	191.15	249.34	267.03	276.32	(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=	489.82	476.3	434.19	361.3	277.51	184.17	122.32	127.99	200.26	304.79	402.55	484.04	(97)

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

(98)m=	150.51	111.65	82.96	37.32	12.94	0	0	0	0	41.26	97.58	154.54	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												688.76	(98)

Space heating requirement in kWh/m²/year

13.78	(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	0.97	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	282.86	226.41	230.32	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	575.77	550.35	520.57	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	210.9	241.01	215.94	0	0	0	0	
Total = Sum(104) =												667.85	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	36.91	42.18	37.79	0	0	0	0		
Total = Sum(107) =													116.87	(107)
Space cooling requirement in kWh/m ² /year													2.34	(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		92.9	(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)

	150.51	111.65	82.96	37.32	12.94	0	0	0	0	41.26	97.58	154.54		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	162.02	120.18	89.3	40.17	13.93	0	0	0	0	44.41	105.04	166.36		
Total (kWh/year) = Sum(211) _{1..5,10...12} =													741.4	(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)

	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95		
Efficiency of water heater													87.3	(216)
(217)m=	88.95	88.82	88.56	88.09	87.64	87.3	87.3	87.3	87.3	88.13	88.69	89		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	152.64	134.15	139.93	124.17	120.91	106.44	100.31	112.72	113.35	128.81	137.74	148.26		
Total = Sum(219a) _{1..12} =													1519.44	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	8.54	9.76	8.75	0	0	0	0		
Total = Sum(221) _{6..8} =													27.05	(221)

Annual totals

	kWh/year		kWh/year
Space heating fuel used, main system 1			741.4
Water heating fuel used			1519.44
Space cooling fuel used			27.05
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside			95.31 (230a)
central heating pump:			30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		232.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2691.15	(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	0.216	=	160.14	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	328.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =			488.34	(265)
Space cooling	(221) x	0.519	=	14.04	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Total CO2, kg/year		sum of (265)...(271) =		711.67	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.23	(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: 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

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)
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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.69	13.26	14.64	14.11	14.54	14.03	14.47	14.52	14.08	14.6	14.18	14.68	(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=	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21	(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=	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21	
Output from water heater (annual) _{1...12}												1700.95	(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=	56.39	49.42	51.24	45.01	43.43	37.85	35.44	40.15	40.47	46.72	50.56	54.72	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	75.79	73.54	68.87	62.51	58.38	52.57	47.64	53.96	56.21	62.79	70.22	73.55	(72)

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

(73)m=	406.58	404.36	389.64	365.86	341.59	318.33	303.31	309.61	321.91	345.91	373.47	394.25	(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	0.9x	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=	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=	461.42	511.36	566.43	626.51	664.75	651.08	619.28	578.33	528.28	472.92	441.76	439.41	(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	0.92	0.83	0.7	0.52	0.39	0.43	0.66	0.88	0.95	0.98	(86)

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

(87)m=	19.75	19.94	20.24	20.61	20.85	20.97	20.99	20.99	20.91	20.59	20.12	19.73	(87)

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

(88)m=	20.4	20.4	20.4	20.42	20.42	20.43	20.43	20.43	20.42	20.42	20.41	20.41	(88)

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

(89)m=	0.97	0.95	0.91	0.82	0.67	0.48	0.34	0.38	0.62	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=	18.69	18.96	19.4	19.92	20.25	20.4	20.42	20.42	20.33	19.9	19.23	18.66	(90)

fLA = Living area ÷ (4) =

0.33 (91)

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

(92)m=	19.04	19.29	19.68	20.15	20.45	20.59	20.61	20.61	20.53	20.13	19.53	19.01	(92)

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

(93)m=	18.89	19.14	19.53	20	20.3	20.44	20.46	20.46	20.38	19.98	19.38	18.86	(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	0.89	0.8	0.66	0.48	0.34	0.38	0.61	0.84	0.93	0.96	(94)

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

(95)m=	441.31	478.91	506.26	502.53	438.82	312.99	211.64	220.61	324.5	398.8	412.82	422.84	(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=	852.34	828.04	754.68	629.54	485.52	322.5	213.46	223.42	349.87	529.62	699.16	842.19	(97)

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

(98)m=	305.8	234.61	184.82	91.45	34.75	0	0	0	0	97.33	206.17	311.99	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1466.94 (99)

Space heating requirement in kWh/m ² /year	15.94	(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	490.4	396.34	401.64	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	854.33	815.36	768.93	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	262.03	311.75	273.26	0	0	0	0	
									Total = Sum(104) =		847.04		(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 × (105) × (106)m													
(107)m=	0	0	0	0	0	24.92	29.65	25.99	0	0	0	0	
									Total = Sum(107) =		80.56		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		0.88		(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

92.9

(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)

305.8	234.61	184.82	91.45	34.75	0	0	0	0	97.33	206.17	311.99

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

(211)

329.17	252.54	198.95	98.44	37.4	0	0	0	0	104.77	221.93	335.84

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

1579.05

(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)

173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21

Efficiency of water heater

87.3

(216)

(217)m=

89.32	89.21	89	88.54	87.94	87.3	87.3	87.3	87.3	88.56	89.1	89.35

(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	193.95	170.28	177.23	156.83	152.65	134.38	126.21	142.44	143.43	162.74	174.61	188.26	
Total = Sum(219a) _{1...12} =													1923.01 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	5.77	6.86	6.02	0	0	0	0	
Total = Sum(221) _{6...8} =													18.65 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

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

Electricity for lighting

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

185.9	(230a)
30	(230c)
45	(230e)
260.9	(231)
393.89	(232)
4175.49	(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	0.216 =	341.07 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	415.37 (264)
Space and water heating	(261) + (262) + (263) + (264) =		756.44 (265)
Space cooling	(221) x	0.519 =	9.68 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	135.41 (267)
Electricity for lighting	(232) x	0.519 =	204.43 (268)
Total CO2, kg/year		sum of (265)...(271) =	1105.96 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.02 (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: 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		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

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.55	13.12	14.49	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	
Output from water heater (annual) _{1...12}												1405.94	(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=	46.23	40.53	42.07	37.01	35.77	31.23	29.31	33.11	33.35	38.42	41.5	44.89	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	62.14	60.32	56.54	51.41	48.07	43.38	39.4	44.51	46.32	51.64	57.64	60.33	(72)

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

(73)m=	293.41	291.65	281.21	264.47	247.7	231.33	220.57	225.61	234.09	251.01	270.45	284.82	(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)

DER WorkSheet: New dwelling design stage

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)

DER WorkSheet: New dwelling design stage

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=	424.42	515.62	588.67	645.32	672.87	652.47	627.02	599.37	567.15	498.92	427.55	396.82	(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	0.62	0.47	0.35	0.38	0.56	0.78	0.9	0.95	(86)

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

(87)m=	19.32	19.66	20.06	20.47	20.76	20.92	20.98	20.97	20.87	20.47	19.83	19.25	(87)

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

(88)m=	20.13	20.13	20.13	20.14	20.14	20.15	20.15	20.16	20.15	20.14	20.14	20.13	(88)

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

(89)m=	0.93	0.88	0.82	0.71	0.58	0.42	0.29	0.31	0.51	0.75	0.89	0.94	(89)

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

(90)m=	17.88	18.36	18.92	19.5	19.88	20.08	20.14	20.13	20.02	19.52	18.62	17.79	(90)

fLA = Living area ÷ (4) =

0.64	(91)

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

(92)m=	18.8	19.19	19.65	20.12	20.44	20.62	20.67	20.67	20.56	20.13	19.39	18.72	(92)

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

(93)m=	18.65	19.04	19.5	19.97	20.29	20.47	20.52	20.52	20.41	19.98	19.24	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=	0.91	0.87	0.8	0.71	0.58	0.44	0.31	0.34	0.52	0.74	0.87	0.92	(94)

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

(95)m=	387.4	446.7	472.26	455.75	392.16	284.66	196.74	204.72	296.25	369.76	373.4	366.72	(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=	763.25	749.95	687.55	577.49	446.96	301.05	201.19	210.56	325.45	487.84	634.96	756.08	(97)

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

(98)m=	279.63	203.79	160.17	87.65	40.77	0	0	0	0	87.86	188.32	289.68

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

1337.88	(98)

Space heating requirement in kWh/m²/year

23.89	(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	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	437.55	357.16	362.22	0	0	0	0	(102)	
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	825.99	795.13	763.56	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	279.68	325.85	298.6	0	0	0	0		
									Total = Sum(104) =		904.12		(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	43.7	50.91	46.66	0	0	0	0		
									Total = Sum(107) =		141.27		(107)	
Space cooling requirement in kWh/m²/year										(107) ÷ (4) =		2.52		(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		92.9	(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)	279.63	203.79	160.17	87.65	40.77	0	0	0	0	87.86	188.32	289.68		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														
	301.01	219.36	172.42	94.35	43.89	0	0	0	0	94.57	202.71	311.82		
											Total (kWh/year) = Sum(211) _{1...5,10...12} =		1440.13	(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)	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.39	89.26	89.04	88.66	88.14	87.3	87.3	87.3	87.3	88.63	89.18	89.44	(217)	

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.58	140.23	146.13	129.48	126.11	111.56	105.06	118.17	118.87	134.41	143.86	154.97	
Total = Sum(219a) _{1...12} =													1588.44 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	10.12	11.79	10.8	0	0	0	0	
Total = Sum(221) _{6...8} =													32.7 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

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

kWh/year

kWh/year

1440.13

1588.44

32.7

106.75

30

45

181.75

256.25

3499.27

(230a)

(230c)

(230e)

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

(231)

(232)

(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	0.216 =	311.07 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	343.1 (264)
Space and water heating	(261) + (262) + (263) + (264) =		654.17 (265)
Space cooling	(221) x	0.519 =	16.97 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	94.33 (267)
Electricity for lighting	(232) x	0.519 =	132.99 (268)
Total CO2, kg/year		sum of (265)...(271) =	898.47 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	16.04 (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: 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) 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

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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.69	13.26	14.64	14.11	14.54	14.03	14.47	14.52	14.08	14.6	14.18	14.68	(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=	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21	(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=	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21	
Output from water heater (annual) _{1...12}												1700.95	(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=	56.39	49.42	51.24	45.01	43.43	37.85	35.44	40.15	40.47	46.72	50.56	54.72	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	75.79	73.54	68.87	62.51	58.38	52.57	47.64	53.96	56.21	62.79	70.22	73.55	(72)

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

(73)m=	406.58	404.36	389.64	365.86	341.59	318.33	303.31	309.61	321.91	345.91	373.47	394.25	(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	=	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	0.9x	<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=	461.42	511.36	566.43	626.51	664.75	651.08	619.28	578.33	528.28	472.92	441.76	439.41	(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	0.73	0.57	0.43	0.47	0.7	0.89	0.96	0.98	(86)

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

(87)m=	19.55	19.74	20.07	20.48	20.78	20.94	20.98	20.98	20.86	20.47	19.95	19.52	(87)

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

(88)m=	20.34	20.34	20.34	20.35	20.36	20.37	20.37	20.37	20.36	20.36	20.35	20.35	(88)

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

(89)m=	0.97	0.95	0.92	0.84	0.7	0.52	0.37	0.41	0.66	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=	18.35	18.63	19.1	19.69	20.1	20.31	20.36	20.35	20.22	19.69	18.94	18.32	(90)

fLA = Living area ÷ (4) =

0.33

 (91)

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

(92)m=	18.75	19	19.43	19.95	20.32	20.52	20.57	20.56	20.43	19.95	19.28	18.72	(92)

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

(93)m=	18.6	18.85	19.28	19.8	20.17	20.37	20.42	20.41	20.28	19.8	19.13	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	0.94	0.9	0.82	0.69	0.52	0.37	0.42	0.65	0.86	0.94	0.96	(94)

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

(95)m=	442.19	480.94	511.26	515	460.41	337.62	230.96	240.14	343.01	405.97	414.76	423.49	(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=	925.01	899.07	820.07	686.72	531.68	355	234.77	245.8	383.53	576.94	760.33	915.39	(97)

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

(98)m=	359.22	280.98	229.76	123.63	53.02	0	0	0	0	127.21	248.81	365.97	

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

1788.61

 (98)

Space heating requirement in kWh/m²/year

19.44

 (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	527.51	431.46	435.4	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	854.33	815.36	768.93	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	235.31	285.63	248.15	0	0	0	0	
									Total = Sum(104) =		769.09		(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 × (105) × (106)m													
(107)m=	0	0	0	0	0	22.38	27.17	23.6	0	0	0	0	
									Total = Sum(107) =		73.15		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		0.8		(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) =												(202)
Fraction of total heating from main system 1	(204) = (202) x [1 – (203)] =												(204)
Efficiency of main space heating system 1	92.9												(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)													
359.22	280.98	229.76	123.63	53.02	0	0	0	0	127.21	248.81	365.97		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
386.68	302.46	247.32	133.08	57.08	0	0	0	0	136.93	267.83	393.94		
Total (kWh/year) =Sum(211) _{1, 5,10,...12} =												1925.31	(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)	173.23	151.92	157.73	138.86	134.24	117.32	110.18	124.35	125.22	144.13	155.57	168.21	
Efficiency of water heater	87.3												(216)
(217)m=	89.43	89.35	89.17	88.78	88.18	87.3	87.3	87.3	87.3	88.77	89.24	89.47	(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	193.7	170.02	176.88	156.41	152.23	134.38	126.21	142.44	143.43	162.36	174.32	188.02	
Total = Sum(219a) _{1...12} =													1920.41 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	5.18	6.29	5.46	0	0	0	0	
Total = Sum(221) _{6...8} =													16.93 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

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

Electricity for lighting

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	0.216 =	415.87 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	414.81 (264)
Space and water heating	(261) + (262) + (263) + (264) =		830.67 (265)
Space cooling	(221) x	0.519 =	8.79 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	135.41 (267)
Electricity for lighting	(232) x	0.519 =	204.43 (268)
Total CO2, kg/year		sum of (265)...(271) =	1179.3 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.82 (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: 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

DER WorkSheet: New dwelling design stage

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

0 (47)

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

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

Water storage loss:

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

0 (48)

Temperature factor from Table 2b

0 (49)

Energy lost from water storage, kWh/year

(48) x (49) =

0 (50)

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

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

0 (51)

If community heating see section 4.3

Volume factor from Table 2a

0 (52)

Temperature factor from Table 2b

0 (53)

Energy lost from water storage, kWh/year

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

0 (54)

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

0 (55)

Water storage loss calculated for each month

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

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0

 (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=

0	0	0	0	0	0	0	0	0	0	0	0

 (57)

DER WorkSheet: New dwelling design stage

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

(59)

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

(61)m=	14.52	13.1	14.47	13.97	14.41	13.92	14.37	14.4	13.95	14.45	14.02	14.51

(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=	136.93	120.16	124.95	110.29	106.83	93.67	88.27	99.2	99.76	114.45	123.19	133.06

(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=	136.93	120.16	124.95	110.29	106.83	93.67	88.27	99.2	99.76	114.45	123.19	133.06

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

1350.75

(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=	44.33	38.87	40.35	35.52	34.33	30	28.16	31.8	32.02	36.86	39.8	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=	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=	3	3	3	3	3	3	3	3	3	3	3	3

(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=	59.59	57.84	54.24	49.33	46.15	41.66	37.85	42.74	44.47	49.55	55.28	57.86

(72)

Total internal gains =

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

(73)m=	274.57	272.89	263.15	247.56	232	216.77	206.72	211.54	219.41	235.17	253.28	266.6

(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	(76)
East	0.9x	0.77	x	2.13	x	38.42	x	0.4	x	0.7	=	31.76	(76)

DER WorkSheet: New dwelling design stage

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)

DER WorkSheet: New dwelling design stage

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=	391.39	476.53	550.98	614.42	648.49	631.7	606.23	574.47	535.03	463.03	394.13	365.93	(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	0.85	0.75	0.63	0.48	0.36	0.39	0.58	0.8	0.91	0.95	(86)

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

(87)m=	19.07	19.42	19.87	20.35	20.69	20.9	20.97	20.96	20.82	20.34	19.62	19	(87)

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

(88)m=	20.04	20.04	20.04	20.05	20.05	20.07	20.07	20.07	20.06	20.05	20.05	20.04	(88)

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

(89)m=	0.93	0.89	0.83	0.72	0.58	0.42	0.29	0.32	0.52	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=	17.47	17.97	18.6	19.26	19.72	19.97	20.04	20.04	19.88	19.27	18.27	17.38	(90)

fLA = Living area ÷ (4) = 0.53 (91)

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

(92)m=	18.31	18.73	19.27	19.84	20.23	20.46	20.53	20.52	20.38	19.84	18.98	18.24	(92)

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

(93)m=	18.16	18.58	19.12	19.69	20.08	20.31	20.38	20.37	20.23	19.69	18.83	18.09	(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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.91	0.87	0.8	0.71	0.58	0.44	0.32	0.35	0.53	0.75	0.87	0.92	(94)

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

(95)m=	356.94	413.55	443.24	435.14	379.26	277.26	191.11	198.7	285.04	346.8	344.79	337.72	(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=	748.14	736.43	677.16	571	442.57	297.26	196.79	206.2	320.74	479.75	622.75	741.19	(97)

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

(98)m=	291.06	216.97	174.04	97.82	47.1	0	0	0	0	98.91	200.13	300.18	(98)

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

1426.22 (98)

Space heating requirement in kWh/m²/year

27.97 (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	432.67	355.43	359.17	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	796.77	766	729.53	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	262.15	305.46	275.55	0	0	0	0	(104)

Total = Sum(104) = 843.17 (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	44.98	52.41	47.28	0	0	0	0	(107)

Total = Sum(107) = 144.66 (107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) = 2.84 (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

92.9 (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)													
	291.06	216.97	174.04	97.82	47.1	0	0	0	0	98.91	200.13	300.18	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)													
	313.3	233.56	187.34	105.3	50.7	0	0	0	0	106.47	215.43	323.12	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1535.22 (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)													
	136.93	120.16	124.95	110.29	106.83	93.67	88.27	99.2	99.76	114.45	123.19	133.06	
Efficiency of water heater													87.3 (216)
(217)m=	89.45	89.33	89.13	88.78	88.25	87.3	87.3	87.3	87.3	88.75	89.25	89.49	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	153.08	134.5	140.18	124.23	121.05	107.3	101.11	113.63	114.27	128.96	138.02	148.68	
Total = Sum(219a) _{1..12} =													1525 (219)
Space cooling fuel, kWh/month.													
(221)m = (107)m ÷ (209)													
(221)m=	0	0	0	0	0	10.41	12.13	10.94	0	0	0	0	
Total = Sum(221) _{6..8} =													33.49 (221)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													1535.22
Water heating fuel used													1525
Space cooling fuel used													33.49
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													97.22 (230a)
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												172.22 (231)
Electricity for lighting													235.9 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													3501.82 (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	0.216	=	331.61 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	329.4 (264)

DER WorkSheet: New dwelling design stage

Space and water heating	(261) + (262) + (263) + (264) =			661.01	(265)
Space cooling	(221) x	0.519	=	17.38	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	89.38	(267)
Electricity for lighting	(232) x	0.519	=	122.43	(268)
Total CO2, kg/year	sum of (265)...(271) =			890.2	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			17.45	(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: 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)	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			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)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.83	0.83	0.83	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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.85	269.18	259.56	244.19	228.87	213.87	203.96	208.75	216.5	232.04	249.89	263.01	(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)

DER WorkSheet: New dwelling design stage

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= 309.8 345.37 385.04 427.19 453.14 443.45 422.54 396.5 362.44 322.45 298.46 295.04 (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)

	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	0.4	0.44	0.66	0.86	0.94	0.96

(86)

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

(87)m= 19.4 19.62 19.98 20.42 20.74 20.92 20.98 20.97 20.84 20.41 19.84 19.36 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.23	20.23	20.23	20.24	20.24	20.26	20.26	20.26	20.25	20.24	20.24	20.24	(88)

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

(89)m=	0.95	0.93	0.89	0.79	0.66	0.48	0.34	0.38	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=	18.07	18.38	18.9	19.52	19.95	20.18	20.24	20.23	20.09	19.52	18.71	18.02	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.67	18.94	19.39	19.93	20.31	20.52	20.57	20.57	20.43	19.93	19.22	18.63	(92)

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

(93)m=	18.52	18.79	19.24	19.78	20.16	20.37	20.42	20.42	20.28	19.78	19.07	18.48	(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	0.65	0.49	0.35	0.39	0.61	0.82	0.91	0.94	(94)

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

(95)m=	290.21	315.48	333.95	332.95	295	216.69	149.12	154.93	220.27	263.77	272.03	278.46	(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=	591.35	575.84	526.38	442.34	342.88	229.96	152.45	159.63	248.01	371.86	488.32	586.15	(97)

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

(98)m=	224.05	174.96	143.17	78.76	35.63	0	0	0	0	80.42	155.72	228.92	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1121.63	(98)

Space heating requirement in kWh/m²/year

22.43	(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	337.53	276.53	279.15	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	575.77	550.35	520.57	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	171.54	203.72	179.62	0	0	0	0	
Total = Sum(104) =												554.88	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	30.02	35.65	31.43	0	0	0	0	
Total = Sum(107) =													97.1 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.94 (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	92.9 (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)

224.05	174.96	143.17	78.76	35.63	0	0	0	0	80.42	155.72	228.92

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

241.17	188.34	154.11	84.78	38.35	0	0	0	0	86.56	167.63	246.41

Total (kWh/year) = Sum(211)_{1..5,10...12} = 1207.35 (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)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater 87.3 (216)

(217)m=	89.27	89.18	88.99	88.61	88.08	87.3	87.3	87.3	87.3	88.6	89.06	89.3	(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	152.11	133.62	139.25	123.44	120.3	106.44	100.31	112.72	113.35	128.12	137.16	147.75	
Total = Sum(219a) _{1..12} =													1514.58 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	6.95	8.25	7.28	0	0	0	0	
Total = Sum(221) _{6..8} =													22.48 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		1207.35
Water heating fuel used		1514.58
Space cooling fuel used		22.48

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 95.31 (230a)

central heating pump: 30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		232.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3147.67	(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	0.216	=	260.79	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	327.15	(264)
Space and water heating	(261) + (262) + (263) + (264) =			587.94	(265)
Space cooling	(221) x	0.519	=	11.67	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Total CO2, kg/year		sum of (265)...(271) =		808.9	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.18	(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: 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

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)
Windows Type 4			1.63	x1/[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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.78	269.12	259.52	244.16	228.84	213.84	203.94	208.72	216.46	231.99	249.83	262.94	(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)	
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)

DER WorkSheet: New dwelling design stage

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

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

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

$(83)m = \begin{array}{|c|} \hline 42.31 \\ \hline \end{array} \begin{array}{|c|} \hline 82.62 \\ \hline \end{array} \begin{array}{|c|} \hline 136.4 \\ \hline \end{array} \begin{array}{|c|} \hline 200.54 \\ \hline \end{array} \begin{array}{|c|} \hline 247.9 \\ \hline \end{array} \begin{array}{|c|} \hline 254.88 \\ \hline \end{array} \begin{array}{|c|} \hline 242.19 \\ \hline \end{array} \begin{array}{|c|} \hline 206.49 \\ \hline \end{array} \begin{array}{|c|} \hline 159.07 \\ \hline \end{array} \begin{array}{|c|} \hline 98.06 \\ \hline \end{array} \begin{array}{|c|} \hline 52.71 \\ \hline \end{array} \begin{array}{|c|} \hline 34.83 \\ \hline \end{array} \quad (83)$

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

$(84)m = \begin{array}{|c|} \hline 313.1 \\ \hline \end{array} \begin{array}{|c|} \hline 351.74 \\ \hline \end{array} \begin{array}{|c|} \hline 395.92 \\ \hline \end{array} \begin{array}{|c|} \hline 444.7 \\ \hline \end{array} \begin{array}{|c|} \hline 476.75 \\ \hline \end{array} \begin{array}{|c|} \hline 468.73 \\ \hline \end{array} \begin{array}{|c|} \hline 446.13 \\ \hline \end{array} \begin{array}{|c|} \hline 415.2 \\ \hline \end{array} \begin{array}{|c|} \hline 375.53 \\ \hline \end{array} \begin{array}{|c|} \hline 330.05 \\ \hline \end{array} \begin{array}{|c|} \hline 302.54 \\ \hline \end{array} \begin{array}{|c|} \hline 297.77 \\ \hline \end{array} \quad (84)$

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)

$(87)m = \begin{array}{|c|} \hline 18.77 \\ \hline \end{array} \begin{array}{|c|} \hline 19.01 \\ \hline \end{array} \begin{array}{|c|} \hline 19.45 \\ \hline \end{array} \begin{array}{|c|} \hline 20 \\ \hline \end{array} \begin{array}{|c|} \hline 20.48 \\ \hline \end{array} \begin{array}{|c|} \hline 20.8 \\ \hline \end{array} \begin{array}{|c|} \hline 20.92 \\ \hline \end{array} \begin{array}{|c|} \hline 20.9 \\ \hline \end{array} \begin{array}{|c|} \hline 20.65 \\ \hline \end{array} \begin{array}{|c|} \hline 20.03 \\ \hline \end{array} \begin{array}{|c|} \hline 19.31 \\ \hline \end{array} \begin{array}{|c|} \hline 18.73 \\ \hline \end{array} \quad (87)$

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

$(88)m = \begin{array}{|c|} \hline 20.01 \\ \hline \end{array} \begin{array}{|c|} \hline 20.01 \\ \hline \end{array} \begin{array}{|c|} \hline 20.01 \\ \hline \end{array} \begin{array}{|c|} \hline 20.02 \\ \hline \end{array} \begin{array}{|c|} \hline 20.02 \\ \hline \end{array} \begin{array}{|c|} \hline 20.03 \\ \hline \end{array} \begin{array}{|c|} \hline 20.03 \\ \hline \end{array} \begin{array}{|c|} \hline 20.04 \\ \hline \end{array} \begin{array}{|c|} \hline 20.03 \\ \hline \end{array} \begin{array}{|c|} \hline 20.02 \\ \hline \end{array} \begin{array}{|c|} \hline 20.02 \\ \hline \end{array} \begin{array}{|c|} \hline 20.02 \\ \hline \end{array} \quad (88)$

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

$(89)m = \begin{array}{|c|} \hline 0.96 \\ \hline \end{array} \begin{array}{|c|} \hline 0.94 \\ \hline \end{array} \begin{array}{|c|} \hline 0.9 \\ \hline \end{array} \begin{array}{|c|} \hline 0.83 \\ \hline \end{array} \begin{array}{|c|} \hline 0.71 \\ \hline \end{array} \begin{array}{|c|} \hline 0.54 \\ \hline \end{array} \begin{array}{|c|} \hline 0.39 \\ \hline \end{array} \begin{array}{|c|} \hline 0.43 \\ \hline \end{array} \begin{array}{|c|} \hline 0.67 \\ \hline \end{array} \begin{array}{|c|} \hline 0.86 \\ \hline \end{array} \begin{array}{|c|} \hline 0.94 \\ \hline \end{array} \begin{array}{|c|} \hline 0.96 \\ \hline \end{array} \quad (89)$

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

$(90)m = \begin{array}{|c|} \hline 17.02 \\ \hline \end{array} \begin{array}{|c|} \hline 17.37 \\ \hline \end{array} \begin{array}{|c|} \hline 18 \\ \hline \end{array} \begin{array}{|c|} \hline 18.79 \\ \hline \end{array} \begin{array}{|c|} \hline 19.44 \\ \hline \end{array} \begin{array}{|c|} \hline 19.85 \\ \hline \end{array} \begin{array}{|c|} \hline 19.98 \\ \hline \end{array} \begin{array}{|c|} \hline 19.97 \\ \hline \end{array} \begin{array}{|c|} \hline 19.68 \\ \hline \end{array} \begin{array}{|c|} \hline 18.84 \\ \hline \end{array} \begin{array}{|c|} \hline 17.81 \\ \hline \end{array} \begin{array}{|c|} \hline 16.96 \\ \hline \end{array} \quad (90)$

$fLA = \text{Living area} \div (4) = \begin{array}{|c|} \hline 0.45 \\ \hline \end{array} \quad (91)$

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

$(92)m = \begin{array}{|c|} \hline 17.82 \\ \hline \end{array} \begin{array}{|c|} \hline 18.12 \\ \hline \end{array} \begin{array}{|c|} \hline 18.65 \\ \hline \end{array} \begin{array}{|c|} \hline 19.34 \\ \hline \end{array} \begin{array}{|c|} \hline 19.91 \\ \hline \end{array} \begin{array}{|c|} \hline 20.28 \\ \hline \end{array} \begin{array}{|c|} \hline 20.41 \\ \hline \end{array} \begin{array}{|c|} \hline 20.39 \\ \hline \end{array} \begin{array}{|c|} \hline 20.12 \\ \hline \end{array} \begin{array}{|c|} \hline 19.38 \\ \hline \end{array} \begin{array}{|c|} \hline 18.49 \\ \hline \end{array} \begin{array}{|c|} \hline 17.76 \\ \hline \end{array} \quad (92)$

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

$(93)m = \begin{array}{|c|} \hline 17.67 \\ \hline \end{array} \begin{array}{|c|} \hline 17.97 \\ \hline \end{array} \begin{array}{|c|} \hline 18.5 \\ \hline \end{array} \begin{array}{|c|} \hline 19.19 \\ \hline \end{array} \begin{array}{|c|} \hline 19.76 \\ \hline \end{array} \begin{array}{|c|} \hline 20.13 \\ \hline \end{array} \begin{array}{|c|} \hline 20.26 \\ \hline \end{array} \begin{array}{|c|} \hline 20.24 \\ \hline \end{array} \begin{array}{|c|} \hline 19.97 \\ \hline \end{array} \begin{array}{|c|} \hline 19.23 \\ \hline \end{array} \begin{array}{|c|} \hline 18.34 \\ \hline \end{array} \begin{array}{|c|} \hline 17.61 \\ \hline \end{array} \quad (93)$

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:

$(94)m = \begin{array}{|c|} \hline 0.94 \\ \hline \end{array} \begin{array}{|c|} \hline 0.92 \\ \hline \end{array} \begin{array}{|c|} \hline 0.88 \\ \hline \end{array} \begin{array}{|c|} \hline 0.81 \\ \hline \end{array} \begin{array}{|c|} \hline 0.69 \\ \hline \end{array} \begin{array}{|c|} \hline 0.55 \\ \hline \end{array} \begin{array}{|c|} \hline 0.41 \\ \hline \end{array} \begin{array}{|c|} \hline 0.45 \\ \hline \end{array} \begin{array}{|c|} \hline 0.66 \\ \hline \end{array} \begin{array}{|c|} \hline 0.84 \\ \hline \end{array} \begin{array}{|c|} \hline 0.92 \\ \hline \end{array} \begin{array}{|c|} \hline 0.95 \\ \hline \end{array} \quad (94)$

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

$(95)m = \begin{array}{|c|} \hline 294.01 \\ \hline \end{array} \begin{array}{|c|} \hline 323.12 \\ \hline \end{array} \begin{array}{|c|} \hline 348.06 \\ \hline \end{array} \begin{array}{|c|} \hline 358.13 \\ \hline \end{array} \begin{array}{|c|} \hline 331.18 \\ \hline \end{array} \begin{array}{|c|} \hline 256.33 \\ \hline \end{array} \begin{array}{|c|} \hline 182.18 \\ \hline \end{array} \begin{array}{|c|} \hline 187.31 \\ \hline \end{array} \begin{array}{|c|} \hline 248.57 \\ \hline \end{array} \begin{array}{|c|} \hline 277.42 \\ \hline \end{array} \begin{array}{|c|} \hline 277.7 \\ \hline \end{array} \begin{array}{|c|} \hline 281.49 \\ \hline \end{array} \quad (95)$

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 = $[(39)m \times ((93)m - (96)m)]$

$(97)m = \begin{array}{|c|} \hline 730.33 \\ \hline \end{array} \begin{array}{|c|} \hline 712.26 \\ \hline \end{array} \begin{array}{|c|} \hline 652.61 \\ \hline \end{array} \begin{array}{|c|} \hline 552.81 \\ \hline \end{array} \begin{array}{|c|} \hline 431.88 \\ \hline \end{array} \begin{array}{|c|} \hline 292.64 \\ \hline \end{array} \begin{array}{|c|} \hline 193.75 \\ \hline \end{array} \begin{array}{|c|} \hline 202.78 \\ \hline \end{array} \begin{array}{|c|} \hline 312.17 \\ \hline \end{array} \begin{array}{|c|} \hline 462.37 \\ \hline \end{array} \begin{array}{|c|} \hline 605.15 \\ \hline \end{array} \begin{array}{|c|} \hline 725.82 \\ \hline \end{array} \quad (97)$

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

$(98)m = \begin{array}{|c|} \hline 324.62 \\ \hline \end{array} \begin{array}{|c|} \hline 261.5 \\ \hline \end{array} \begin{array}{|c|} \hline 226.58 \\ \hline \end{array} \begin{array}{|c|} \hline 140.17 \\ \hline \end{array} \begin{array}{|c|} \hline 74.92 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 0 \\ \hline \end{array} \begin{array}{|c|} \hline 137.6 \\ \hline \end{array} \begin{array}{|c|} \hline 235.77 \\ \hline \end{array} \begin{array}{|c|} \hline 330.58 \\ \hline \end{array} \quad (98)$

Total per year (kWh/year) = $\text{Sum}(98)_{1..5,9..12} = \begin{array}{|c|} \hline 1731.75 \\ \hline \end{array} \quad (98)$

Space heating requirement in kWh/m²/year $\begin{array}{|c|} \hline 34.63 \\ \hline \end{array} \quad (99)$

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	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	0.86	0.83	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	398.25	335.2	334.02	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	605.28	577.9	542.39	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	149.07	180.56	155.03	0	0	0	0	
									Total = Sum(104) =			484.66	(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	26.09	31.6	27.13	0	0	0	0	
									Total = Sum(107) =			84.82	(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =			1.7	(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												92.9	(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)															
324.62	261.5	226.58	140.17	74.92	0	0	0	0	137.6	235.77	330.58				
(211)m = {[(98)m × (204)] } × 100 ÷ (206)												(211)			
349.43	281.49	243.9	150.88	80.65	0	0	0	0	148.12	253.78	355.84				
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1864.1	(211)		
Space heating fuel (secondary), kWh/month															
= {[(98)m × (201)] } × 100 ÷ (208)															
(215)m=												0	(215)		
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)	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Efficiency of water heater													87.3 (216)
(217)m=	89.53	89.47	89.34	89.07	88.6	87.3	87.3	87.3	87.3	89.02	89.38	89.56	(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	151.66	133.17	138.69	122.81	119.6	106.44	100.31	112.72	113.35	127.51	136.67	147.32	
Total = Sum(219a) _{1...12} =													1510.27 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	6.04	7.31	6.28	0	0	0	0	
Total = Sum(221) _{6...8} =													19.63 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

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

95.31 (230a)
30 (230c)
45 (230e)
sum of (230a)...(230g) = 170.31 (231)
231.81 (232)
3796.13 (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	0.216 =	402.65 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	326.22 (264)
Space and water heating	(261) + (262) + (263) + (264) =		728.86 (265)
Space cooling	(221) x	0.519 =	10.19 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	88.39 (267)
Electricity for lighting	(232) x	0.519 =	120.31 (268)
Total CO2, kg/year		sum of (265)...(271) =	947.76 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	18.96 (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: 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)	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

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.65	13.21	14.58	14.06	14.5	13.99	14.43	14.47	14.03	14.55	14.13	14.64	(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=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	(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	0	(63)

Output from water heater

(64)m=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	
Output from water heater (annual) _{1...12}												1583.44	(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=	52.35	45.88	47.58	41.82	40.38	35.21	33	37.34	37.64	43.41	46.95	50.81	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	70.36	68.27	63.95	58.09	54.27	48.91	44.35	50.19	52.27	58.35	65.21	68.29	(72)

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

(73)m=	357.49	355.36	342.39	321.59	300.56	280.32	267.2	273.09	283.81	304.82	328.89	346.86	(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)

DER WorkSheet: New dwelling design stage

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= 409.55 451.05 488.17 520.96 536.54 518.97 495.55 474.25 448.58 414.94 392.62 390.48 (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	0.95	0.92	0.85	0.75	0.59	0.44	0.48	0.69	0.88	0.95	0.97

(86)

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

(87)m= 19.56 19.75 20.06 20.45 20.74 20.92 20.98 20.97 20.86 20.47 19.96 19.53 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.31	20.31	20.32	20.33	20.33	20.34	20.34	20.34	20.34	20.33	20.33	20.32	(88)

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

(89)m=	0.96	0.94	0.91	0.84	0.71	0.54	0.38	0.42	0.64	0.86	0.94	0.97	(89)

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

(90)m=	18.35	18.63	19.07	19.62	20.03	20.27	20.33	20.32	20.19	19.67	18.94	18.31	(90)

fLA = Living area ÷ (4) =	0.35	(91)

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

(92)m=	18.77	19.02	19.41	19.91	20.28	20.49	20.55	20.55	20.42	19.95	19.29	18.73	(92)

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

(93)m=	18.62	18.87	19.26	19.76	20.13	20.34	20.4	20.4	20.27	19.8	19.14	18.58	(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	0.82	0.7	0.54	0.39	0.42	0.64	0.84	0.92	0.95	(94)

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

(95)m=	388.1	418.52	434.88	426.5	377.48	279.22	192.55	200.36	286.94	348.19	363.03	372.48	(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=	776.93	755.2	687.69	574.47	444.21	297.17	196.67	205.99	321.55	485	639.52	769.16	(97)

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

(98)m=	289.29	226.25	188.09	106.54	49.64	0	0	0	0	101.79	199.07	295.14	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1455.81	(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	486.33	382.85	391.72	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.9	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	435.94	358.73	363.02	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	687.04	658.21	634.54	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	180.79	222.81	202.01	0	0	0	0	
Total = Sum(104) =												605.61	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	21.38	26.35	23.89	0	0	0	0		
Total = Sum(107) =													71.61	(107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) =

0.97 (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

92.9 (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)

289.29	226.25	188.09	106.54	49.64	0	0	0	0	101.79	199.07	295.14

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

(211)

311.39	243.54	202.47	114.68	53.44	0	0	0	0	109.57	214.29	317.69

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

1567.07 (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)

161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43

Efficiency of water heater

87.3 (216)

(217)m=	89.33	89.24	89.07	88.72	88.19	87.3	87.3	87.3	87.3	88.65	89.12	89.37

(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	180.31	158.29	164.73	145.71	141.79	125.29	117.78	132.77	133.64	151.34	162.36	175.05

Total = Sum(219a)_{1..12} =

1789.06 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	4.95	6.1	5.53	0	0	0	0

Total = Sum(221)_{6..8} =

16.58 (221)

Annual totals

Space heating fuel used, main system 1

1567.07

Water heating fuel used

1789.06

Space cooling fuel used

16.58

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

141.06 (230a)

central heating pump:

30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	216.06	(231)
Electricity for lighting		346.14	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3934.91	(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	0.216	=	338.49	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	386.44	(264)
Space and water heating	(261) + (262) + (263) + (264) =			724.92	(265)
Space cooling	(221) x	0.519	=	8.6	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	112.14	(267)
Electricity for lighting	(232) x	0.519	=	179.65	(268)
Total CO2, kg/year		sum of (265)...(271) =		1025.31	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.86	(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-01-02

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) 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)
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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.85	269.18	259.56	244.19	228.87	213.87	203.96	208.75	216.5	232.04	249.89	263.01	(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	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)

DER WorkSheet: New dwelling design stage

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= 318.37 357.43 395.88 432.87 453.71 441.8 421.84 399.73 371.39 334.15 308.24 302.7 (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	0.81	0.68	0.53	0.39	0.43	0.64	0.84	0.93	0.96

(86)

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

(87)m= 19.48 19.71 20.05 20.47 20.76 20.93 20.98 20.97 20.86 20.47 19.91 19.44 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.24	20.24	20.25	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.26	20.25	(88)

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

(89)m=	0.95	0.92	0.88	0.78	0.65	0.47	0.33	0.37	0.59	0.82	0.92	0.95	(89)

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

(90)m=	18.19	18.51	19.01	19.59	19.99	20.2	20.26	20.25	20.13	19.61	18.82	18.14	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.78	19.06	19.48	19.99	20.34	20.53	20.58	20.58	20.46	20	19.32	18.73	(92)

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

(93)m=	18.63	18.91	19.33	19.84	20.19	20.38	20.43	20.43	20.31	19.85	19.17	18.58	(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	0.86	0.77	0.64	0.48	0.35	0.38	0.59	0.8	0.9	0.94	(94)

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

(95)m=	296.81	323.83	339.73	333.59	292.26	213.3	146.44	152.39	219.39	268.49	278.69	284.54	(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=	582.49	567.63	518.47	434.68	336.31	225.28	149.37	156.43	243.5	366.32	481.12	577.1	(97)

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

(98)m=	212.55	163.83	132.98	72.78	32.78	0	0	0	0	72.79	145.75	217.66	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1051.12	(98)

Space heating requirement in kWh/m²/year

21.02	(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	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	332.35	271.75	275	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	573.84	549.53	524.34	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	173.87	206.67	185.51	0	0	0	0	
Total = Sum(104) =												566.06	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	30.43	36.17	32.47	0	0	0	0		
Total = Sum(107) =													99.06	(107)
Space cooling requirement in kWh/m ² /year													1.98	(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		92.9	(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)												
212.55	163.83	132.98	72.78	32.78	0	0	0	0	72.79	145.75	217.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)												(211)
228.79	176.35	143.15	78.34	35.28	0	0	0	0	78.35	156.89	234.3	
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1131.45 (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)													
135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95		
Efficiency of water heater												87.3	(216)
(217)m=	89.23	89.12	88.93	88.55	88.04	87.3	87.3	87.3	87.3	88.52	89.01	89.27	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	152.18	133.69	139.34	123.53	120.37	106.44	100.31	112.72	113.35	128.23	137.24	147.81	
Total = Sum(219a) _{1...12} =												1515.23	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)													
(221)m=	0	0	0	0	0	7.04	8.37	7.52	0	0	0	0	
Total = Sum(221) _{6...8} =												22.93	(221)

Annual totals

		kWh/year	kWh/year
Space heating fuel used, main system 1		1131.45	
Water heating fuel used		1515.23	
Space cooling fuel used		22.93	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		95.31	(230a)
central heating pump:		30	(230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		232.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3072.87	(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	0.216	=	244.39	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	327.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =			571.68	(265)
Space cooling	(221) x	0.519	=	11.9	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Total CO2, kg/year		sum of (265)...(271) =		792.88	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.86	(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: 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

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	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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34	(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)	
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)

DER WorkSheet: New dwelling design stage

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=	303.91	333.5	365.26	398.18	417.51	406.94	387.8	366.71	339.37	308.3	291.02	290.26	(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	0.5	0.37	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=	19.76	19.95	20.25	20.61	20.84	20.96	20.99	20.99	20.91	20.6	20.13	19.73	(87)

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

(88)m=	20.34	20.35	20.35	20.36	20.36	20.37	20.37	20.37	20.37	20.36	20.36	20.35	(88)

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

(89)m=	0.95	0.93	0.88	0.78	0.63	0.46	0.32	0.35	0.58	0.82	0.92	0.95	(89)

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

(90)m=	18.67	18.93	19.37	19.87	20.18	20.33	20.36	20.36	20.28	19.87	19.21	18.62	(90)

fLA = Living area ÷ (4) =

0.45 (91)

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

(92)m=	19.16	19.4	19.77	20.2	20.48	20.62	20.65	20.65	20.56	20.2	19.63	19.13	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	19.01	19.25	19.62	20.05	20.33	20.47	20.5	20.5	20.41	20.05	19.48	18.98	(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=	0.93	0.91	0.86	0.77	0.63	0.46	0.33	0.36	0.58	0.8	0.91	0.94	(94)

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

(95)m=	283.85	303.55	314.89	305.92	263.83	188.63	128.24	133.7	196.45	247.58	263.55	273.26	(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=	512.12	497.6	453.43	378.79	292.17	195.11	129.61	135.68	211.45	319.82	421.92	507.18	(97)

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

(98)m=	169.83	130.4	103.08	52.46	21.09	0	0	0	0	53.74	114.02	174.04	
Total per year ($kWh/year$) = $Sum(98)_{1..12} =$												818.67	(98)

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

16.37	(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	293.96	237.7	241.31	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	533.25	509.9	485.96	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	172.29	202.52	182.01	0	0	0	0	
Total = $Sum(104) =$												556.82	(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	30.15	35.44	31.85	0	0	0	0	
Total = $Sum(107) =$												97.44	(107)

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

$(107) \div (4) =$	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 $(204) = (202) \times [1 - (203)] =$

1	(204)

DER WorkSheet: New dwelling design stage

Efficiency of main space heating system 1	92.9	(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)

169.83	130.4	103.08	52.46	21.09	0	0	0	0	53.74	114.02	174.04

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

182.81	140.37	110.95	56.47	22.7	0	0	0	0	57.85	122.74	187.34

Total (kWh/year) =Sum(211)_{1..5,10...12} = 881.24 (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)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater 87.3 (216)

(217)m= 89.05 88.94 88.72 88.31 87.82 87.3 87.3 87.3 87.3 88.3 88.82 89.09 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	152.48	133.97	139.66	123.86	120.67	106.44	100.31	112.72	113.35	128.55	137.54	148.1

Total = Sum(219a)_{1..12} = 1517.66 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	6.98	8.2	7.37	0	0	0	0

Total = Sum(221)_{6..8} = 22.56 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	881.24	
Water heating fuel used	1517.66	
Space cooling fuel used	22.56	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 95.31 (230a)

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 170.31 (231)

Electricity for lighting 238.63 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 2830.4 (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	0.216 =	190.35 (261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	327.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =			518.16	(265)
Space cooling	(221) x	0.519	=	11.71	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year	sum of (265)...(271) =			742.11	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.84	(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-01-04

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)	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	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			2.13	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	0	(47)

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

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

Water storage loss:

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

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.68	13.25	14.62	14.1	14.53	14.02	14.46	14.51	14.06	14.59	14.17	14.67	(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=	169.92	149.02	154.73	136.25	131.73	115.16	108.18	122.05	122.89	141.41	152.62	165.01	(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=	169.92	149.02	154.73	136.25	131.73	115.16	108.18	122.05	122.89	141.41	152.62	165.01	
Output from water heater (annual) _{1...12}												1668.96	(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=	55.29	48.46	50.24	44.14	42.6	37.13	34.78	39.38	39.7	45.82	49.58	53.66	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	74.31	72.11	67.53	61.3	57.26	51.57	46.74	52.94	55.14	61.58	68.86	72.12	(72)

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

(73)m=	390.98	388.87	374.81	352.08	328.92	306.62	292.15	298.25	309.93	332.88	359.28	379.14	(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)

DER WorkSheet: New dwelling design stage

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)

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=	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=	465.01	526.55	591.95	666.07	719.3	710.57	674.82	621.84	560.49	492.99	450.11	441.08	(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	0.54	0.41	0.46	0.68	0.88	0.95	0.97	(86)

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

(87)m=	19.39	19.62	19.98	20.43	20.76	20.93	20.98	20.97	20.84	20.41	19.83	19.36	(87)

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

(88)m=	20.27	20.27	20.27	20.28	20.29	20.3	20.3	20.3	20.29	20.29	20.28	20.28	(88)

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

(89)m=	0.97	0.95	0.91	0.82	0.67	0.49	0.35	0.39	0.63	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=	18.08	18.41	18.93	19.56	20.01	20.23	20.28	20.28	20.13	19.55	18.72	18.03	(90)

fLA = Living area ÷ (4) =

0.17

 (91)

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

(92)m=	18.3	18.61	19.11	19.71	20.13	20.35	20.4	20.39	20.25	19.69	18.91	18.26	(92)

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

(93)m=	18.15	18.46	18.96	19.56	19.98	20.2	20.25	20.24	20.1	19.54	18.76	18.11	(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	0.66	0.48	0.34	0.39	0.62	0.84	0.93	0.96	(94)

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

(95)m=	441.5	488.03	522.49	528.45	471.83	343.1	231.3	240.84	347.28	412.19	417.07	421.65	(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=	933.63	910.91	833.7	701.51	543.18	360.86	235.29	246.92	389.36	586.33	769.94	924.68	(97)

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

(98)m=	366.15	284.17	231.55	124.6	53.08	0	0	0	0	129.56	254.07	374.26

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

1817.43

 (98)

Space heating requirement in kWh/m ² /year	21.13	(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	0.91	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	548.37	448.73	451.57	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	919.6	876.09	815.41	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	267.29	317.96	270.7	0	0	0	0	
									Total = Sum(104) =		855.94		(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	27.19	32.35	27.54	0	0	0	0	
									Total = Sum(107) =		87.09		(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =		1.01		(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													92.9 (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)													
366.15	284.17	231.55	124.6	53.08	0	0	0	0	129.56	254.07	374.26		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
394.13	305.89	249.24	134.13	57.14	0	0	0	0	139.46	273.48	402.86		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1956.33	(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)													
	169.92	149.02	154.73	136.25	131.73	115.16	108.18	122.05	122.89	141.41	152.62	165.01	
Efficiency of water heater													87.3 (216)
(217)m=	89.46	89.37	89.19	88.8	88.2	87.3	87.3	87.3	87.3	88.8	89.27	89.5	(217)

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	189.94	166.74	173.48	153.43	149.37	131.91	123.91	139.8	140.77	159.25	170.96	184.37	
Total = Sum(219a) _{1...12} =													1883.93 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	6.3	7.49	6.38	0	0	0	0	
Total = Sum(221) _{6...8} =													20.16 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

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

kWh/year

kWh/year

173.77	(230a)
30	(230c)
45	(230e)

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

1956.33	(231)
1883.93	(232)
20.16	(233)
248.77	(234)
364.52	(235)
4473.71	(236)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	422.57 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	406.93 (264)
Space and water heating	(261) + (262) + (263) + (264) =		829.5 (265)
Space cooling	(221) x	0.519 =	10.46 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	129.11 (267)
Electricity for lighting	(232) x	0.519 =	189.18 (268)
Total CO2, kg/year	sum of (265)...(271) =		1158.26 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =		13.47 (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

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			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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.7	13.26	14.65	14.13	14.56	14.04	14.48	14.53	14.09	14.61	14.19	14.69	(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=	175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78	(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=	175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78	
Output from water heater (annual) _{1...12}												1726.51	(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=	57.27	50.19	52.03	45.7	44.1	38.42	35.97	40.76	41.09	47.44	51.34	55.57	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	76.97	74.68	69.93	63.47	59.27	53.37	48.35	54.78	57.07	63.76	71.31	74.69	(72)

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

(73)m=	421.59	419.16	403.69	378.79	353.39	329.2	313.7	320.28	333.29	358.41	387.16	408.84	(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)

DER WorkSheet: New dwelling design stage

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=	488.94	533.06	559.49	575.26	579.1	556.43	531.42	515.25	502.79	484.07	467.62	466.63	(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	0.58	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=	19.94	20.1	20.33	20.63	20.84	20.96	20.99	20.99	20.93	20.67	20.27	19.91	(87)

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

(88)m=	20.45	20.46	20.46	20.47	20.47	20.48	20.48	20.49	20.48	20.47	20.47	20.46	(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	0.54	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=	18.99	19.23	19.57	19.99	20.28	20.45	20.48	20.48	20.4	20.06	19.49	18.97	(90)

fLA = Living area ÷ (4) =

0.33 (91)

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

(92)m=	19.3	19.51	19.82	20.2	20.47	20.61	20.64	20.64	20.57	20.26	19.74	19.27	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	19.15	19.36	19.67	20.05	20.32	20.46	20.49	20.49	20.42	20.11	19.59	19.12	(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	0.9	0.83	0.72	0.54	0.38	0.41	0.63	0.84	0.93	0.96	(94)

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

(95)m=	466.53	498.33	504.47	479.75	415.42	299.88	204.45	213.23	316.3	405.57	434.61	448.07	(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=	836.61	811.12	735.02	607.84	467.66	310.77	206.39	215.88	338.33	515.97	684.54	825.46	(97)

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

(98)m=	275.34	210.2	171.53	92.23	38.87	0	0	0	0	82.14	179.95	280.77	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1331.01	(98)

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

13.58	(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	467.17	379.34	385.64	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	748	716.92	699.77	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	202.2	251.15	233.71	0	0	0	0	
Total = $Sum(104) =$												687.06	(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 = $Sum(104) =$												0	(106)

Space cooling requirement for month = $(104)m \times (105) \times (106)m$

(107)m=	0	0	0	0	0	18.05	22.42	20.87	0	0	0	0	
Total = $Sum(107) =$												61.34	(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)

DER WorkSheet: New dwelling design stage

Efficiency of main space heating system 1	92.9	(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)

275.34	210.2	171.53	92.23	38.87	0	0	0	0	82.14	179.95	280.77

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

296.38	226.26	184.64	99.27	41.84	0	0	0	0	88.41	193.7	302.23

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1432.74 \quad (211)$$

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

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

Water heating

Output from water heater (calculated above)

175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78

Efficiency of water heater 87.3 (216)

(217)m=	89.23	89.12	88.93	88.54	87.99	87.3	87.3	87.3	87.3	88.42	88.98	89.26	(217)

Fuel for water heating, kWh/month

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	197.12	173.07	180.06	159.19	154.84	136.36	128.04	144.54	145.56	165.44	177.5	191.32

$$\text{Total} = \text{Sum}(219a)_{1..12} = 1953.05 \quad (219)$$

Space cooling fuel, kWh/month.

$$(221)m = (107)m \div (209)$$

(221)m=	0	0	0	0	0	4.18	5.19	4.83	0	0	0	0

$$\text{Total} = \text{Sum}(221)_{6..8} = 14.2 \quad (221)$$

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	1432.74	
Water heating fuel used	1953.05	
Space cooling fuel used	14.2	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 198.02 (230a)

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 273.02 (231)

Electricity for lighting 437.37 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 4110.38 (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	0.216	= 309.47 (261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	421.86	(264)
Space and water heating	(261) + (262) + (263) + (264) =			731.33	(265)
Space cooling	(221) x	0.519	=	7.37	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	141.7	(267)
Electricity for lighting	(232) x	0.519	=	227	(268)
Total CO2, kg/year	sum of (265)...(271) =			1107.39	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.3	(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-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

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	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
Average = Sum(39)_{1...12} /12= 45.46 (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	0.61	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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.65	13.21	14.58	14.06	14.5	13.99	14.43	14.47	14.03	14.55	14.13	14.64	(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=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	(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	0	(63)

Output from water heater

(64)m=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	
Output from water heater (annual) _{1...12}												1583.44	(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=	52.35	45.88	47.58	41.82	40.38	35.21	33	37.34	37.64	43.41	46.95	50.81	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	70.36	68.27	63.95	58.09	54.27	48.91	44.35	50.19	52.27	58.35	65.21	68.29	(72)

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

(73)m=	357.49	355.36	342.39	321.59	300.56	280.32	267.2	273.09	283.81	304.82	328.89	346.86	(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)

DER WorkSheet: New dwelling design stage

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= 409.55 451.05 488.17 520.96 536.54 518.97 495.55 474.25 448.58 414.94 392.62 390.48 (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	0.9	0.82	0.69	0.52	0.39	0.42	0.63	0.85	0.94	0.97

(86)

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

(87)m= 19.86 20.04 20.31 20.64 20.86 20.97 20.99 20.99 20.93 20.65 20.21 19.83 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.4	20.4	20.4	20.42	20.42	20.43	20.43	20.43	20.43	20.42	20.41	20.41	(88)

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

(89)m=	0.96	0.94	0.89	0.8	0.66	0.48	0.34	0.37	0.59	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=	18.84	19.1	19.5	19.96	20.25	20.4	20.42	20.42	20.35	19.98	19.36	18.8	(90)

fLA = Living area ÷ (4) =	0.35	(91)

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

(92)m=	19.19	19.43	19.78	20.19	20.46	20.59	20.62	20.62	20.55	20.21	19.65	19.16	(92)

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

(93)m=	19.04	19.28	19.63	20.04	20.31	20.44	20.47	20.47	20.4	20.06	19.5	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	0.88	0.79	0.66	0.48	0.34	0.37	0.59	0.81	0.92	0.95	(94)

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

(95)m=	386.35	415	427.65	411.28	353.14	251.3	170.15	177.56	264.22	337.65	359.56	371.1	(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=	690.79	670.93	610.18	507.03	390.12	259.1	171.63	179.65	281.7	428.61	566.88	682.45	(97)

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

(98)m=	226.5	171.99	135.8	68.94	27.51	0	0	0	0	67.67	149.27	231.64	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1079.33	(98)

Space heating requirement in kWh/m²/year

14.59	(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	393.75	318.27	323.46	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	687.04	658.21	634.54	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	211.17	252.91	231.45	0	0	0	0	
Total = Sum(104) =												695.53	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	24.97	29.91	27.37	0	0	0	0	
Total = Sum(107) =													82.24 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.11 (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 92.9 (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)

226.5	171.99	135.8	68.94	27.51	0	0	0	0	67.67	149.27	231.64

(211)m = {[(98)m × (204)] } × 100 ÷ (206) 243.81 185.13 146.18 74.21 29.62 0 0 0 0 72.84 160.67 249.35 (211)

Total (kWh/year) = Sum(211) _{1..5,10...12} =												1161.82 (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)

161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43

Efficiency of water heater 87.3 (216)

(217)m= 89.14 89.03 88.81 88.39 87.86 87.3 87.3 87.3 87.3 88.35 88.9 89.18 (217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	180.69	158.67	165.21	146.25	142.32	125.29	117.78	132.77	133.64	151.86	162.78	175.41	
Total = Sum(219a) _{1..12} =													1792.67 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	5.78	6.92	6.33	0	0	0	0	
Total = Sum(221) _{6..8} =													19.04 (221)

Annual totals

Space heating fuel used, main system 1 kWh/year kWh/year 1161.82

Water heating fuel used 1792.67

Space cooling fuel used 19.04

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 141.06 (230a)

central heating pump: 30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	216.06	(231)
Electricity for lighting		346.14	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3535.73	(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	0.216	=	250.95	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	387.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =			638.17	(265)
Space cooling	(221) x	0.519	=	9.88	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	112.14	(267)
Electricity for lighting	(232) x	0.519	=	179.65	(268)
Total CO2, kg/year		sum of (265)...(271) =		939.83	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.7	(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: 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) 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)
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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.85	269.18	259.56	244.19	228.87	213.87	203.96	208.75	216.5	232.04	249.89	263.01	(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	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)

DER WorkSheet: New dwelling design stage

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= 318.37 357.43 395.88 432.87 453.71 441.8 421.84 399.73 371.39 334.15 308.24 302.7 (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	0.77	0.64	0.47	0.35	0.38	0.59	0.81	0.92	0.95

(86)

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

(87)m= 19.76 19.98 20.29 20.64 20.86 20.97 20.99 20.99 20.92 20.63 20.15 19.73 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.33	20.33	20.33	20.35	20.35	20.36	20.36	20.36	20.35	20.35	20.34	20.34	(88)

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

(89)m=	0.94	0.91	0.86	0.75	0.6	0.43	0.3	0.33	0.54	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=	18.65	18.96	19.41	19.9	20.19	20.33	20.35	20.35	20.28	19.89	19.22	18.61	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	19.16	19.42	19.81	20.23	20.49	20.62	20.64	20.64	20.57	20.23	19.64	19.12	(92)

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

(93)m=	19.01	19.27	19.66	20.08	20.34	20.47	20.49	20.49	20.42	20.08	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=	0.93	0.9	0.84	0.74	0.6	0.44	0.31	0.34	0.55	0.78	0.89	0.94	(94)

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

(95)m=	295.26	320.71	333.36	320.87	273.4	193.41	130.95	136.62	203	260.19	275.8	283.32	(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=	524.47	510.67	465.75	388.46	299.09	199.16	132.16	138.35	216.2	327.91	432.08	518.75	(97)

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

(98)m=	170.53	127.65	98.5	48.67	19.12	0	0	0	0	50.39	112.52	175.16	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												802.53	(98)

Space heating requirement in kWh/m²/year

16.05	(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	302.17	243.67	247.58	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	573.84	549.53	524.34	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	195.6	227.56	205.91	0	0	0	0	
Total = Sum(104) =												629.08	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	34.23	39.82	36.03	0	0	0	0		
Total = Sum(107) =													110.09	(107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 2.2 (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	92.9	(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)

170.53	127.65	98.5	48.67	19.12	0	0	0	0	50.39	112.52	175.16

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

183.56	137.41	106.03	52.39	20.58	0	0	0	0	54.24	121.12	188.55

Total (kWh/year) = Sum(211)_{1..5,10...12} = 863.87 (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)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater 87.3 (216)

(217)m=	89.05	88.93	88.69	88.26	87.77	87.3	87.3	87.3	87.3	88.26	88.81	89.1		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	152.47	133.99	139.72	123.93	120.72	106.44	100.31	112.72	113.35	128.62	137.56	148.09		
Total = Sum(219a) _{1..12} =													1517.94	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	7.92	9.22	8.34	0	0	0	0		
Total = Sum(221) _{6..8} =													25.48	(221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		863.87
Water heating fuel used		1517.94
Space cooling fuel used		25.48

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 95.31 (230a)

central heating pump: 30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		232.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2810.55	(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		0.216	=	186.6	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	327.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =				514.47	(265)
Space cooling	(221) x		0.519	=	13.23	(266)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	88.39	(267)
Electricity for lighting	(232) x		0.519	=	120.9	(268)
Total CO2, kg/year		sum of (265)...(271) =			736.99	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			14.74	(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-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
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125

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			3
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12

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 $TFA \leq 13.9$, $N = 1$

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

 (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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

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

1339.68

 (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=

43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36

 (72)

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

(73)m=

271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34

 (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)							
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=	303.91	333.5	365.26	398.18	417.51	406.94	387.8	366.71	339.37	308.3	291.02	290.26	(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	0.75	0.6	0.44	0.32	0.35	0.55	0.8	0.91	0.95	(86)

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

(87)m=	20.07	20.24	20.5	20.77	20.93	20.99	21	21	20.96	20.76	20.38	20.04	(87)

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

(88)m=	20.43	20.44	20.44	20.45	20.45	20.46	20.46	20.46	20.46	20.45	20.45	20.44	(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	0.28	0.31	0.52	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=	19.17	19.41	19.78	20.17	20.37	20.45	20.46	20.46	20.42	20.15	19.63	19.13	(90)

fLA = Living area ÷ (4) =

0.45

(91)

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

(92)m=	19.58	19.79	20.11	20.44	20.62	20.69	20.7	20.7	20.66	20.43	19.97	19.54	(92)

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

(93)m=	19.43	19.64	19.96	20.29	20.47	20.54	20.55	20.55	20.51	20.28	19.82	19.39	(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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.93	0.9	0.84	0.73	0.57	0.41	0.29	0.32	0.52	0.77	0.89	0.93	(94)

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

(95)m=	281.27	298.99	306.05	288.77	239.93	165.59	111.29	116.23	176.41	236.15	259.07	271.12	(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=	450.81	437.52	397.83	329.99	252.99	167.84	111.67	116.82	182.72	279.16	370.03	445.53	(97)

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

(98)m=	126.13	93.1	68.28	29.68	9.72	0	0	0	0	32	79.89	129.76	(98)

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

568.56 (98)

Space heating requirement in kWh/m²/year

11.37 (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	258.59	206.28	210.19	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	533.25	509.9	485.96	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	197.75	225.89	205.17	0	0	0	0	(104)

Total = Sum(104) = 628.82 (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	34.61	39.53	35.9	0	0	0	0	(107)

Total = Sum(107) = 110.04 (107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) = 2.2 (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

92.9 (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)													
	126.13	93.1	68.28	29.68	9.72	0	0	0	0	32	79.89	129.76	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)													
	135.77	100.21	73.5	31.95	10.46	0	0	0	0	34.45	86	139.68	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													612.01 (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)													
	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Efficiency of water heater													87.3 (216)
(217)m=	88.81	88.68	88.41	87.96	87.56	87.3	87.3	87.3	87.3	87.98	88.54	88.86	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	152.89	134.37	140.16	124.35	121.02	106.44	100.31	112.72	113.35	129.02	137.98	148.49	
Total = Sum(219a) _{1..12} =													1521.1 (219)
Space cooling fuel, kWh/month.													
(221)m = (107)m ÷ (209)													
(221)m=	0	0	0	0	0	8.01	9.15	8.31	0	0	0	0	
Total = Sum(221) _{6..8} =													25.47 (221)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													612.01
Water heating fuel used													1521.1
Space cooling fuel used													25.47
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													95.31 (230a)
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												170.31 (231)
Electricity for lighting													238.63 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													2567.53 (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	0.216 =	132.19 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	328.56 (264)

DER WorkSheet: New dwelling design stage

Space and water heating	(261) + (262) + (263) + (264) =			460.75	(265)
Space cooling	(221) x	0.519	=	13.22	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year	sum of (265)...(271) =			686.21	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			13.72	(273)
EI 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-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)	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	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			2.13	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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.68	13.25	14.62	14.1	14.53	14.02	14.46	14.51	14.06	14.59	14.17	14.67	(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=	169.92	149.02	154.73	136.25	131.73	115.16	108.18	122.05	122.89	141.41	152.62	165.01	(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=	169.92	149.02	154.73	136.25	131.73	115.16	108.18	122.05	122.89	141.41	152.62	165.01	
Output from water heater (annual) _{1...12}												1668.96	(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=	55.29	48.46	50.24	44.14	42.6	37.13	34.78	39.38	39.7	45.82	49.58	53.66	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	74.31	72.11	67.53	61.3	57.26	51.57	46.74	52.94	55.14	61.58	68.86	72.12	(72)

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

(73)m=	390.98	388.87	374.81	352.08	328.92	306.62	292.15	298.25	309.93	332.88	359.28	379.14	(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)

DER WorkSheet: New dwelling design stage

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)

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=

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=

465.01	526.55	591.95	666.07	719.3	710.57	674.82	621.84	560.49	492.99	450.11	441.08

 (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	0.9	0.81	0.66	0.48	0.36	0.4	0.63	0.86	0.95	0.97

 (86)

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

(87)m=

19.68	19.9	20.23	20.61	20.86	20.97	20.99	20.99	20.91	20.58	20.07	19.65

 (87)

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

(88)m=

20.36	20.36	20.36	20.37	20.37	20.39	20.39	20.39	20.38	20.37	20.37	20.36

 (88)

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

(89)m=

0.96	0.94	0.89	0.79	0.63	0.44	0.31	0.35	0.59	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=

18.55	18.87	19.34	19.88	20.21	20.35	20.38	20.38	20.29	19.85	19.13	18.51

 (90)

fLA = Living area ÷ (4) =

0.17

 (91)

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

(92)m=

18.74	19.04	19.49	20.01	20.32	20.46	20.48	20.48	20.39	19.97	19.29	18.7

 (92)

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

(93)m=

18.59	18.89	19.34	19.86	20.17	20.31	20.33	20.33	20.24	19.82	19.14	18.55

 (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	0.87	0.77	0.61	0.44	0.31	0.35	0.58	0.82	0.92	0.95

 (94)

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

(95)m=

440.36	485.07	515.1	510.41	441.66	310.59	206.94	216.17	322.82	402.18	414.41	420.84

 (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=

840.34	819.34	748.98	626.82	482.64	318.77	208.51	218.68	345.94	525.3	691.41	830.77

 (97)

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

(98)m=

297.58	224.63	174.01	83.81	30.49	0	0	0	0	91.6	199.45	304.99

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

1406.55

 (98)

Space heating requirement in kWh/m²/year

16.36

 (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	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	497.13	400.86	405.95	0	0	0	0	(102)		
Gains (solar gains calculated for applicable weather region, see Table 10)															
(103)m=	0	0	0	0	0	919.6	876.09	815.41	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	304.18	353.57	304.64	0	0	0	0			
										Total = Sum(104) =		962.4	(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 x (105) x (106)m															
(107)m=	0	0	0	0	0	30.95	35.97	31	0	0	0	0			
										Total = Sum(107) =		97.92	(107)		
Space cooling requirement in kWh/m²/year										(107) ÷ (4) =		1.14	(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												92.9	(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)															
	297.58	224.63	174.01	83.81	30.49	0	0	0	0	91.6	199.45	304.99			
(211)m = {[(98)m x (204)] } x 100 ÷ (206)															
	320.33	241.8	187.31	90.22	32.82	0	0	0	0	98.6	214.69	328.3			
												Total (kWh/year) = Sum(211) _{1...5,10...12} =		1514.05	(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)															
	169.92	149.02	154.73	136.25	131.73	115.16	108.18	122.05	122.89	141.41	152.62	165.01			
Efficiency of water heater												87.3	(216)		
(217)m=	89.31	89.2	88.97	88.49	87.88	87.3	87.3	87.3	87.3	88.53	89.08	89.35	(217)		

DER WorkSheet: New dwelling design stage

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	190.26	167.07	173.92	153.97	149.9	131.91	123.91	139.8	140.77	159.74	171.32	184.68	
Total = Sum(219a) _{1...12} =													1887.24 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	7.16	8.33	7.17	0	0	0	0	
Total = Sum(221) _{6...8} =													22.67 (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

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

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

kWh/year

kWh/year

173.77	(230a)
30	(230c)
45	(230e)

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

1514.05	(231)
1887.24	(232)
22.67	(233)
248.77	(234)
364.52	(235)
4037.24	(236)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	327.03 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	407.64 (264)
Space and water heating	(261) + (262) + (263) + (264) =		734.68 (265)
Space cooling	(221) x	0.519 =	11.76 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	129.11 (267)
Electricity for lighting	(232) x	0.519 =	189.18 (268)
Total CO2, kg/year	sum of (265)...(271) =		1064.74 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =		12.38 (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: 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

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			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)

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

2.72

(42)

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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.7	13.26	14.65	14.13	14.56	14.04	14.48	14.53	14.09	14.61	14.19	14.69	(61)

DER WorkSheet: New dwelling design stage

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

(62)m=

175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78

 (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=

175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78

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

1726.51

 (64)

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

(65)m=

57.27	50.19	52.03	45.7	44.1	38.42	35.97	40.76	41.09	47.44	51.34	55.57

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

76.97	74.68	69.93	63.47	59.27	53.37	48.35	54.78	57.07	63.76	71.31	74.69

 (72)

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

(73)m=

421.59	419.16	403.69	378.79	353.39	329.2	313.7	320.28	333.29	358.41	387.16	408.84

 (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=

488.94	533.06	559.49	575.26	579.1	556.43	531.42	515.25	502.79	484.07	467.62	466.63

 (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	0.94	0.9	0.81	0.67	0.49	0.36	0.38	0.58	0.82	0.93	0.97

 (86)

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

(87)m=

20.27	20.41	20.6	20.82	20.94	20.99	21	21	20.98	20.84	20.54	20.25

 (87)

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

(88)m=

20.54	20.55	20.55	20.56	20.56	20.58	20.58	20.58	20.57	20.56	20.56	20.55

 (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	0.46	0.32	0.35	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=

19.54	19.75	20.02	20.33	20.49	20.57	20.57	20.58	20.55	20.36	19.94	19.52

 (90)

fLA = Living area ÷ (4) =

0.33

(91)

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

(92)m=

19.77	19.97	20.21	20.49	20.64	20.7	20.71	20.71	20.69	20.52	20.14	19.76

 (92)

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

(93)m=

19.62	19.82	20.06	20.34	20.49	20.55	20.56	20.56	20.54	20.37	19.99	19.61

 (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=	0.94	0.92	0.87	0.78	0.64	0.46	0.32	0.35	0.55	0.79	0.91	0.95	(94)

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

(95)m=	461.84	489.66	488.89	450.17	372.03	254.75	170.88	178.35	275.03	381.12	425.5	444.2	(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=	713.38	690.55	624.32	511.82	391.07	257.27	171.2	178.81	281.46	434.52	580.14	701.32	(97)

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

(98)m=	187.15	135	100.76	44.39	14.17	0	0	0	0	39.73	111.34	191.3	(98)

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

823.83

Space heating requirement in kWh/m²/year

8.41 (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	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	398.21	317.05	323.14	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	748	716.92	699.77	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	251.85	297.5	280.21	0	0	0	0	(104)

Total = Sum(104) =

829.56

Cooled fraction

f C = cooled area ÷ (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	(106)

Total = Sum(104) =

0

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

(107)m=	0	0	0	0	0	22.49	26.56	25.02	0	0	0	0	(107)

Total = Sum(107) =

74.07

Space cooling requirement in kWh/m²/year

(107) ÷ (4) =

0.76 (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

92.9 (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)													
	187.15	135	100.76	44.39	14.17	0	0	0	0	39.73	111.34	191.3	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)													
	201.45	145.31	108.46	47.78	15.25	0	0	0	0	42.76	119.85	205.92	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													886.79 (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)													
	175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78	
Efficiency of water heater													87.3 (216)
(217)m=	88.92	88.76	88.51	88.05	87.59	87.3	87.3	87.3	87.3	87.96	88.6	88.96	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	197.79	173.75	180.91	160.08	155.54	136.36	128.04	144.54	145.56	166.31	178.26	191.97	
Total = Sum(219a) _{1..12} =													1959.13 (219)
Space cooling fuel, kWh/month.													
(221)m = (107)m ÷ (209)													
(221)m=	0	0	0	0	0	5.21	6.15	5.79	0	0	0	0	
Total = Sum(221) _{6..8} =													17.15 (221)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													886.79
Water heating fuel used													1959.13
Space cooling fuel used													17.15
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													198.02 (230a)
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												273.02 (231)
Electricity for lighting													437.37 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													3573.46 (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	0.216 =	191.55 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	423.17 (264)

DER WorkSheet: New dwelling design stage

Space and water heating	(261) + (262) + (263) + (264) =			614.72	(265)
Space cooling	(221) x	0.519	=	8.9	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	141.7	(267)
Electricity for lighting	(232) x	0.519	=	227	(268)
Total CO2, kg/year	sum of (265)...(271) =			992.31	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			10.13	(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: 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) 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		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

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	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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.65	13.21	14.58	14.06	14.5	13.99	14.43	14.47	14.03	14.55	14.13	14.64	(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=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	(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	0	(63)

Output from water heater

(64)m=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	
Output from water heater (annual) _{1...12}												1583.44	(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=	52.35	45.88	47.58	41.82	40.38	35.21	33	37.34	37.64	43.41	46.95	50.81	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	70.36	68.27	63.95	58.09	54.27	48.91	44.35	50.19	52.27	58.35	65.21	68.29	(72)

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

(73)m=	357.49	355.36	342.39	321.59	300.56	280.32	267.2	273.09	283.81	304.82	328.89	346.86	(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)

DER WorkSheet: New dwelling design stage

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= 409.55 451.05 488.17 520.96 536.54 518.97 495.55 474.25 448.58 414.94 392.62 390.48 (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	0.83	0.7	0.54	0.4	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= 19.8 19.99 20.27 20.61 20.84 20.96 20.99 20.99 20.92 20.62 20.17 19.78 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.38	20.39	20.39	20.4	20.4	20.42	20.42	20.42	20.41	20.4	20.4	20.39	(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	0.49	0.35	0.38	0.6	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=	18.75	19.02	19.42	19.9	20.22	20.38	20.41	20.41	20.32	19.93	19.29	18.72	(90)

fLA = Living area ÷ (4) =	0.35	(91)

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

(92)m=	19.12	19.35	19.72	20.15	20.43	20.58	20.61	20.61	20.53	20.17	19.59	19.08	(92)

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

(93)m=	18.97	19.2	19.57	20	20.28	20.43	20.46	20.46	20.38	20.02	19.44	18.93	(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	0.8	0.67	0.49	0.35	0.38	0.6	0.82	0.92	0.95	(94)

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

(95)m=	386.74	415.77	429.19	414.43	357.95	256.5	174.15	181.66	268.62	339.86	360.32	371.41	(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=	705.69	685.53	623.62	518.77	399.53	265.69	175.95	184.2	288.64	438.42	579.47	697.46	(97)

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

(98)m=	237.3	181.28	144.66	75.12	30.93	0	0	0	0	73.34	157.79	242.57	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1143	(98)

Space heating requirement in kWh/m²/year

15.45	(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	0.97	0.96	0	0	0	0	(101)

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

(102)m=	0	0	0	0	0	401.67	325.64	330.73	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	687.04	658.21	634.54	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	205.47	247.43	226.04	0	0	0	0	
Total = Sum(104) =												678.94	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	24.3	29.26	26.73	0	0	0	0		
Total = Sum(107) =													80.28	(107)
Space cooling requirement in kWh/m ² /year													1.08	(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		92.9	(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)

237.3	181.28	144.66	75.12	30.93	0	0	0	0	73.34	157.79	242.57		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)												(211)	
255.44	195.13	155.72	80.86	33.3	0	0	0	0	78.94	169.85	261.11		
Total (kWh/year) =Sum(211) _{1..5,10...12} =												1230.35	(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)

	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43		
Efficiency of water heater													87.3	(216)
(217)m=	89.18	89.07	88.86	88.45	87.92	87.3	87.3	87.3	87.3	88.4	88.94	89.22	(217)	

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m													
(219)m=	180.61	158.6	165.12	146.15	142.22	125.29	117.78	132.77	133.64	151.76	162.7	175.34	
Total = Sum(219a) _{1...12} =												1791.98	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)												
(221)m=	0	0	0	0	0	5.62	6.77	6.19	0	0	0	
Total = Sum(221) _{6...8} =											18.58	(221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		1230.35
Water heating fuel used		1791.98
Space cooling fuel used		18.58
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	141.06	(230a)
central heating pump:	30	(230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	216.06	(231)
Electricity for lighting		346.14	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3603.12	(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	0.216	=	265.76	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	387.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =			652.82	(265)
Space cooling	(221) x	0.519	=	9.64	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	112.14	(267)
Electricity for lighting	(232) x	0.519	=	179.65	(268)
Total CO2, kg/year		sum of (265)...(271) =		954.25	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.9	(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: 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) 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

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			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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.7	13.26	14.65	14.13	14.56	14.04	14.48	14.53	14.09	14.61	14.19	14.69	(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=	175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78	(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=	175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78	
Output from water heater (annual) _{1...12}												1726.51	(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=	57.27	50.19	52.03	45.7	44.1	38.42	35.97	40.76	41.09	47.44	51.34	55.57	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	76.97	74.68	69.93	63.47	59.27	53.37	48.35	54.78	57.07	63.76	71.31	74.69	(72)

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

(73)m=	421.59	419.16	403.69	378.79	353.39	329.2	313.7	320.28	333.29	358.41	387.16	408.84	(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)

DER WorkSheet: New dwelling design stage

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=	488.94	533.06	559.49	575.26	579.1	556.43	531.42	515.25	502.79	484.07	467.62	466.63	(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	0.74	0.57	0.42	0.45	0.66	0.86	0.95	0.97	(86)

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

(87)m=	19.98	20.14	20.37	20.65	20.86	20.97	20.99	20.99	20.94	20.69	20.31	19.95	(87)

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

(88)m=	20.46	20.47	20.47	20.48	20.48	20.5	20.5	20.5	20.49	20.48	20.48	20.47	(88)

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

(89)m=	0.96	0.95	0.91	0.84	0.72	0.53	0.38	0.41	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=	19.06	19.29	19.62	20.03	20.31	20.46	20.49	20.49	20.42	20.1	19.54	19.03	(90)

fLA = Living area ÷ (4) =

0.33 (91)

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

(92)m=	19.36	19.57	19.87	20.23	20.49	20.63	20.65	20.65	20.59	20.29	19.79	19.33	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	19.21	19.42	19.72	20.08	20.34	20.48	20.5	20.5	20.44	20.14	19.64	19.18	(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	0.9	0.83	0.71	0.53	0.38	0.41	0.62	0.83	0.93	0.96	(94)

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

(95)m=	466.14	497.59	503.1	477.01	411.04	294.79	200.44	209.09	311.88	403.32	433.84	447.76	(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, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	821.52	796.38	721.52	596.17	458.34	304.2	202.05	211.32	331.39	506.08	671.79	810.26	(97)

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

(98)m=	264.4	200.79	162.51	85.79	35.19	0	0	0	0	76.45	171.33	269.7	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1266.15	(98)

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

12.92	(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	459.53	372.1	378.44	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	748	716.92	699.77	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	207.7	256.55	239.07	0	0	0	0	
Total = $Sum(104) =$												703.32	(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	18.54	22.91	21.35	0	0	0	0	
Total = $Sum(107) =$												62.8	(107)

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

$(107) \div (4) =$	0.64	(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	92.9	(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)

264.4	200.79	162.51	85.79	35.19	0	0	0	0	76.45	171.33	269.7

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

(211)

284.61	216.13	174.93	92.35	37.88	0	0	0	0	82.29	184.42	290.31

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

1362.92 (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

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} =$$

0 (215)

Water heating

Output from water heater (calculated above)

175.88	154.23	160.12	140.95	136.24	119.05	111.78	126.19	127.08	146.29	157.93	170.78

Efficiency of water heater

87.3 (216)

(217)m=	89.19	89.08	88.88	88.48	87.94	87.3	87.3	87.3	87.3	88.37	88.94	89.23

(217)

Fuel for water heating, kWh/month

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	197.19	173.14	180.15	159.29	154.93	136.36	128.04	144.54	145.56	165.54	177.58	191.39

$$\text{Total} = \text{Sum}(219a)_{1..12} =$$

1953.71 (219)

Space cooling fuel, kWh/month.

$$(221)m = (107)m \div (209)$$

(221)m=	0	0	0	0	0	4.29	5.3	4.94	0	0	0	0

$$\text{Total} = \text{Sum}(221)_{6..8} =$$

14.54 (221)

Annual totals

Space heating fuel used, main system 1

1362.92 kWh/year

Water heating fuel used

1953.71 kWh/year

Space cooling fuel used

14.54 kWh/year

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

198.02 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

$$\text{sum of (230a)...(230g)} =$$

273.02 (231)

Electricity for lighting

437.37 (232)

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

4041.56 (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	0.216	= 294.39 (261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	422	(264)
Space and water heating	(261) + (262) + (263) + (264) =			716.39	(265)
Space cooling	(221) x	0.519	=	7.54	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	141.7	(267)
Electricity for lighting	(232) x	0.519	=	227	(268)
Total CO2, kg/year	sum of (265)...(271) =			1092.63	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.15	(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-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)

DER WorkSheet: New dwelling design stage

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)

	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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.63	13.19	14.57	14.05	14.49	13.98	14.42	14.46	14.02	14.53	14.12	14.62	(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=	158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83	(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=	158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83	
Output from water heater (annual) _{1...12}												1557.5	(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=	51.45	45.1	46.78	41.12	39.71	34.63	32.46	36.73	37.01	42.68	46.15	49.94	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	69.16	67.11	62.87	57.11	53.37	48.1	43.63	49.36	51.4	57.37	64.1	67.13	(72)

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

(73)m=	346.99	344.99	332.51	312.45	292.17	272.57	259.79	265.49	275.76	296.02	319.29	336.65	(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)

DER WorkSheet: New dwelling design stage

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=

395.96	440.78	490.28	542.54	574.16	561.23	534.61	501.55	459.25	409.69	380.35	376.93

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.97	0.96	0.93	0.87	0.76	0.61	0.48	0.52	0.73	0.9	0.96	0.97

 (86)

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

(87)m=

19.1	19.32	19.7	20.19	20.59	20.86	20.95	20.94	20.74	20.21	19.57	19.06

 (87)

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

(88)m=

20.16	20.16	20.17	20.18	20.18	20.19	20.19	20.19	20.19	20.18	20.18	20.17

 (88)

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

(89)m=

0.96	0.95	0.92	0.85	0.73	0.56	0.4	0.44	0.68	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=

17.59	17.9	18.45	19.16	19.71	20.05	20.16	20.14	19.91	19.19	18.29	17.54

 (90)

fLA = Living area ÷ (4) =

0.36

 (91)

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

(92)m=

18.13	18.41	18.9	19.53	20.03	20.34	20.44	20.43	20.21	19.56	18.75	18.09

 (92)

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

DER WorkSheet: New dwelling design stage

(93)m=	17.98	18.26	18.75	19.38	19.88	20.19	20.29	20.28	20.06	19.41	18.6	17.94	(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	0.82	0.71	0.56	0.41	0.45	0.67	0.86	0.93	0.96	(94)

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

(95)m=	376.03	410.57	438.8	446.95	408.99	312.26	219.1	226.46	308.31	350.41	353.8	360.11	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	880.61	857.44	783.8	660.59	514.06	346.25	228.6	239.45	371.35	553.72	727.23	873.91	(97)

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

(98)m=	375.41	300.3	256.69	153.82	78.17	0	0	0	0	151.26	268.87	382.26	
Total per year (kWh/year) = Sum(98) _{1..5,9..12} =												1966.79	(98)

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

27.7	(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	0.84	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	487.19	407.43	408.2	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	733.5	700.96	663.39	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	177.35	218.39	189.86	0	0	0	0	
Total = Sum(104) =												585.6	(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	21.86	26.91	23.4	0	0	0	0	
Total = Sum(107) =												72.17	(107)

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

(107) $\div (4) =$	1.02	(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	92.9	(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)

375.41	300.3	256.69	153.82	78.17	0	0	0	0	151.26	268.87	382.26

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

404.11	323.25	276.3	165.58	84.15	0	0	0	0	162.82	289.42	411.48

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

2117.1

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} = (215)

0

Water heating

Output from water heater (calculated above)

158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83

Efficiency of water heater (216)

(217)m=

89.53	89.46	89.32	89.02	88.52	87.3	87.3	87.3	87.3	88.98	89.37	89.56

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

176.9	155.27	161.55	142.83	138.97	123.29	115.92	130.63	131.49	148.31	159.24	171.76

Total = Sum(219a)_{1...12} = (219)

1756.16

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=

0	0	0	0	0	5.06	6.23	5.42	0	0	0	0

Total = Sum(221)_{6...8} = (221)

16.71

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	2117.1	
Water heating fuel used	1756.16	
Space cooling fuel used	16.71	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside (230a)

135.34

central heating pump: (230c)

30

boiler with a fan-assisted flue (230e)

45

Total electricity for the above, kWh/year (231)

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

210.34

Electricity for lighting (232)

320.72

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = (338)

4421.03

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	457.29 (261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	379.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			836.62	(265)
Space cooling	(221) x	0.519	=	8.67	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	109.17	(267)
Electricity for lighting	(232) x	0.519	=	166.45	(268)
Total CO2, kg/year	sum of (265)...(271) =			1120.92	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			15.79	(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-04-02

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)	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			1.63	x 1/[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)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.85	269.18	259.56	244.19	228.87	213.87	203.96	208.75	216.5	232.04	249.89	263.01	(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	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)

DER WorkSheet: New dwelling design stage

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= 318.37 357.43 395.88 432.87 453.71 441.8 421.84 399.73 371.39 334.15 308.24 302.7 (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	0.66	0.5	0.37	0.4	0.61	0.83	0.93	0.96

(86)

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

(87)m= 19.63 19.85 20.18 20.56 20.82 20.95 20.99 20.98 20.9 20.56 20.04 19.59 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.29	20.29	20.29	20.31	20.31	20.32	20.32	20.32	20.31	20.31	20.3	20.3	(88)

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

(89)m=	0.95	0.92	0.87	0.77	0.62	0.45	0.32	0.35	0.56	0.8	0.92	0.95	(89)

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

(90)m=	18.44	18.76	19.23	19.76	20.1	20.27	20.31	20.31	20.21	19.76	19.04	18.39	(90)

fLA = Living area ÷ (4) =	0.45	(91)

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

(92)m=	18.98	19.25	19.66	20.12	20.43	20.58	20.62	20.61	20.52	20.12	19.49	18.94	(92)

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

(93)m=	18.83	19.1	19.51	19.97	20.28	20.43	20.47	20.46	20.37	19.97	19.34	18.79	(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	0.76	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=	296.08	322.34	336.63	327.31	282.71	202.93	138.22	144.05	211.01	264.42	277.31	283.97	(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=	551.24	536.97	490.11	409.85	316.31	211.21	140.09	146.68	228.83	345.69	454.73	545.68	(97)

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

(98)m=	189.84	144.23	114.19	59.43	25	0	0	0	0	60.47	127.74	194.71	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												915.61	(98)

Space heating requirement in kWh/m²/year

18.31	(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	316.67	256.96	260.62	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	573.84	549.53	524.34	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	185.16	217.68	196.21	0	0	0	0	
Total = Sum(104) =												599.05	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	32.4	38.09	34.34	0	0	0	0		
Total = Sum(107) =													104.83	(107)
Space cooling requirement in kWh/m ² /year													2.1	(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		92.9	(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)													
189.84	144.23	114.19	59.43	25	0	0	0	0	60.47	127.74	194.71		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
204.35	155.26	122.92	63.97	26.91	0	0	0	0	65.09	137.51	209.59		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												985.59	(211)

Space heating fuel (secondary), kWh/month

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

Water heating

Output from water heater (calculated above)													
135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95		
Efficiency of water heater												87.3	(216)
(217)m=	89.14	89.02	88.81	88.4	87.89	87.3	87.3	87.3	87.3	88.39	88.91	89.18	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	152.33	133.84	139.53	123.74	120.56	106.44	100.31	112.72	113.35	128.43	137.4	147.96	
Total = Sum(219a) _{1...12} =												1516.63	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)													
(221)m=	0	0	0	0	0	7.5	8.82	7.95	0	0	0	0	
Total = Sum(221) _{6...8} =												24.27	(221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		985.59
Water heating fuel used		1516.63
Space cooling fuel used		24.27
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	95.31	(230a)
central heating pump:	30	(230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		232.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2929.75	(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	0.216	=	212.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	327.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			540.48	(265)
Space cooling	(221) x	0.519	=	12.59	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	120.9	(268)
Total CO2, kg/year		sum of (265)...(271) =		762.37	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.25	(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: 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
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			125

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			3
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12

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 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)

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

 (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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

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

1339.68

 (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=

43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36

 (72)

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

(73)m=

271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34

 (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)							
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=	303.91	333.5	365.26	398.18	417.51	406.94	387.8	366.71	339.37	308.3	291.02	290.26	(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	0.63	0.47	0.34	0.38	0.59	0.82	0.92	0.96	(86)

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

(87)m=	19.93	20.11	20.39	20.7	20.89	20.98	20.99	20.99	20.94	20.69	20.27	19.9	(87)

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

(88)m=	20.39	20.39	20.4	20.41	20.41	20.42	20.42	20.42	20.42	20.41	20.41	20.4	(88)

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

(89)m=	0.94	0.92	0.86	0.76	0.6	0.43	0.3	0.33	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=	18.93	19.19	19.59	20.03	20.29	20.4	20.42	20.42	20.36	20.02	19.44	18.9	(90)

fLA = Living area ÷ (4) =

0.45

(91)

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

(92)m=	19.39	19.61	19.95	20.34	20.56	20.66	20.68	20.68	20.62	20.33	19.81	19.35	(92)

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

(93)m=	19.24	19.46	19.8	20.19	20.41	20.51	20.53	20.53	20.47	20.18	19.66	19.2	(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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.93	0.9	0.85	0.75	0.6	0.43	0.31	0.34	0.55	0.79	0.9	0.94	(94)

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

(95)m=	282.66	301.42	310.69	297.57	251.75	176.54	119.18	124.4	186.2	242.07	261.46	272.28	(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=	479.09	465.25	423.52	352.57	271.08	180.38	119.91	125.49	195.98	297.98	394	473.97	(97)

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

(98)m=	146.14	110.1	83.95	39.6	14.38	0	0	0	0	41.59	95.43	150.05	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 681.25 (98)

Space heating requirement in kWh/m²/year

13.62 (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	275.51	221.05	224.91	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	533.25	509.9	485.96	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	185.57	214.9	194.22	0	0	0	0	(104)

Total = Sum(104) = 594.7 (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	32.48	37.61	33.99	0	0	0	0	(107)

Total = Sum(107) = 104.07 (107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) = 2.08 (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

92.9 (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)															
	146.14	110.1	83.95	39.6	14.38	0	0	0	0	41.59	95.43	150.05			
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)															
	157.31	118.51	90.36	42.63	15.48	0	0	0	0	44.77	102.72	161.52			
Total (kWh/year) = Sum(211) _{1..5,10...12} =													733.31 (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)															
	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95			
Efficiency of water heater													87.3 (216)		
(217)m=	88.93	88.81	88.56	88.13	87.67	87.3	87.3	87.3	87.3	88.14	88.68	88.97	(217)		
Fuel for water heating, kWh/month															
(219)m = (64)m x 100 ÷ (217)m															
(219)m=	152.68	134.17	139.91	124.12	120.87	106.44	100.31	112.72	113.35	128.8	137.76	148.3			
Total = Sum(219a) _{1..12} =													1519.44 (219)		
Space cooling fuel, kWh/month.															
(221)m = (107)m ÷ (209)															
(221)m=	0	0	0	0	0	7.52	8.71	7.87	0	0	0	0			
Total = Sum(221) _{6..8} =													24.09 (221)		
Annual totals															
													kWh/year	kWh/year	
Space heating fuel used, main system 1														733.31	
Water heating fuel used														1519.44	
Space cooling fuel used														24.09	
Electricity for pumps, fans and electric keep-hot															
mechanical ventilation - balanced, extract or positive input from outside													95.31	(230a)	
central heating pump:													30	(230c)	
boiler with a fan-assisted flue													45	(230e)	
Total electricity for the above, kWh/year													sum of (230a)...(230g) =		170.31 (231)
Electricity for lighting														238.63 (232)	
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =														2685.79 (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	0.216	=	158.4 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	328.2 (264)

DER WorkSheet: New dwelling design stage

Space and water heating	(261) + (262) + (263) + (264) =			486.59	(265)
Space cooling	(221) x	0.519	=	12.5	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year	sum of (265)...(271) =			711.34	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.23	(273)
EI 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-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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

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

(73)m=	270.78	269.12	259.52	244.16	228.84	213.84	203.94	208.72	216.46	231.99	249.83	262.94	(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)	
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)

DER WorkSheet: New dwelling design stage

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= 316.71 358.36 407.8 466.74 509.99 505.99 480.24 439.98 390.6 337.97 306.91 300.85 (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	0.68	0.53	0.4	0.45	0.67	0.86	0.94	0.96

(86)

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

(87)m= 19.12 19.36 19.77 20.29 20.68 20.9 20.97 20.95 20.78 20.26 19.6 19.07 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.12	20.13	20.13	20.14	20.14	20.15	20.15	20.16	20.15	20.14	20.14	20.13	(88)

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

(89)m=	0.95	0.93	0.89	0.79	0.64	0.47	0.33	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=	17.59	17.94	18.53	19.26	19.78	20.06	20.13	20.12	19.93	19.24	18.31	17.53	(90)

fLA = Living area ÷ (4) =	0.58	(91)

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

(92)m=	18.47	18.76	19.25	19.86	20.3	20.54	20.61	20.6	20.42	19.83	19.06	18.42	(92)

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

(93)m=	18.32	18.61	19.1	19.71	20.15	20.39	20.46	20.45	20.27	19.68	18.91	18.27	(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=	0.94	0.91	0.87	0.78	0.65	0.49	0.36	0.4	0.62	0.83	0.91	0.95	(94)

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

(95)m=	297.14	327.76	353.87	362.7	329.03	246.1	171.53	177.14	243.1	279.09	280.7	284.33	(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=	667.02	650.43	596.07	504.04	393	265.58	177.14	185.22	284.54	422.25	552.27	661.99	(97)

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

(98)m=	275.19	216.83	180.19	101.77	47.59	0	0	0	0	106.51	195.54	280.97	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1404.6	(98)

Space heating requirement in kWh/m²/year

28.09	(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	378.88	311.81	312.53	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	648.84	617.77	571.35	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	194.37	227.64	192.56	0	0	0	0	
Total = Sum(104) =												614.57	(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)

DER WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	34.01	39.84	33.7	0	0	0	0		
Total = Sum(107) =													107.55	(107)
Space cooling requirement in kWh/m ² /year													2.15	(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		92.9	(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)

	275.19	216.83	180.19	101.77	47.59	0	0	0	0	106.51	195.54	280.97		
(211)m = {[(98)m × (204)] } × 100 ÷ (206)														(211)
	296.22	233.41	193.97	109.54	51.23	0	0	0	0	114.65	210.48	302.45		
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1511.95	(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)

	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95		
Efficiency of water heater													87.3	(216)
(217)m=	89.42	89.34	89.17	88.81	88.27	87.3	87.3	87.3	87.3	88.82	89.24	89.45		(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m														
(219)m=	151.85	133.37	138.96	123.16	120.05	106.44	100.31	112.72	113.35	127.81	136.89	147.51		
Total = Sum(219a) _{1..12} =													1512.43	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)														
(221)m=	0	0	0	0	0	7.87	9.22	7.8	0	0	0	0		
Total = Sum(221) _{6..8} =													24.9	(221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		1511.95
Water heating fuel used		1512.43
Space cooling fuel used		24.9
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	95.31	(230a)
central heating pump:	30	(230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		231.81	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3451.4	(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	0.216	=	326.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	326.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =			653.27	(265)
Space cooling	(221) x	0.519	=	12.92	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	120.31	(268)
Total CO2, kg/year		sum of (265)...(271) =		874.89	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.5	(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-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)	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	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			2.13	x 1/[1/(1.2)+0.04]	= 2.44		(27)
Windows Type 2			2.13	x 1/[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 (39)

Average = Sum(39)_{1...12} /12= 49.69 (39)

DER WorkSheet: New dwelling design stage

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.58	13.15	14.52	14.02	14.45	13.95	14.4	14.43	13.99	14.5	14.07	14.57	(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=	149.31	130.99	136.12	120.03	116.17	101.73	95.74	107.77	108.44	124.57	134.23	145.05	(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=	149.31	130.99	136.12	120.03	116.17	101.73	95.74	107.77	108.44	124.57	134.23	145.05	
Output from water heater (annual) _{1...12}												1470.15	(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=	48.44	42.47	44.06	38.75	37.44	32.67	30.64	34.64	34.9	40.22	43.47	47.03	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	65.11	63.2	59.22	53.82	50.32	45.38	41.19	46.56	48.47	54.06	60.37	63.21	(72)

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

(73)m=	315.97	314.07	302.74	284.57	266.3	248.57	236.98	242.33	251.61	269.97	291.04	306.67	(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	2.13	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)

DER WorkSheet: New dwelling design stage

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=	345.39	371.03	397.86	429.62	452.42	443.44	420.68	394.05	363.91	337.65	327.55	331.01	(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	0.88	0.78	0.62	0.48	0.53	0.74	0.9	0.95	0.97	(86)

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

(87)m=	19.32	19.5	19.82	20.26	20.64	20.88	20.96	20.95	20.77	20.3	19.75	19.29	(87)

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

(88)m=	20.24	20.24	20.24	20.25	20.25	20.27	20.27	20.27	20.26	20.25	20.25	20.24	(88)

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

(89)m=	0.96	0.95	0.92	0.86	0.74	0.57	0.41	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=	17.96	18.21	18.68	19.32	19.83	20.15	20.24	20.23	20.02	19.38	18.59	17.92	(90)

fLA = Living area ÷ (4) =

0.44 (91)

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

(92)m=	18.56	18.78	19.18	19.73	20.19	20.47	20.56	20.54	20.35	19.79	19.1	18.53	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	18.41	18.63	19.03	19.58	20.04	20.32	20.41	20.39	20.2	19.64	18.95	18.38	(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	0.84	0.73	0.57	0.42	0.47	0.69	0.86	0.93	0.96	(94)

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

(95)m=	328.08	347.18	360.4	361.71	331.35	253.7	178.69	184.54	251.01	291.47	304.99	316.16	(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=	717.77	696.12	633.43	531.26	413.23	278.87	185.54	194.08	299.46	448.05	591.35	711.92	(97)

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

(98)m=	289.93	234.48	203.13	122.08	60.92	0	0	0	0	116.5	206.18	294.45	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1527.67	(98)

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

24.64	(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	0.86	0.9	0.89	0	0	0	0	(101)

Useful loss, $h_m L_m$ (Watts) = $(100)m \times (101)m$

(102)m=	0	0	0	0	0	392.05	326.31	327.34	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	587.69	559.85	529.66	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	140.86	173.76	150.53	0	0	0	0	
Total = $Sum(104) =$												465.15	(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	19.88	24.52	21.24	0	0	0	0	
Total = $Sum(107) =$												65.65	(107)

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

$(107) \div (4) =$	1.06	(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 $(204) = (202) \times [1 - (203)] =$ 1 (204)

DER WorkSheet: New dwelling design stage

Efficiency of main space heating system 1	92.9	(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)

289.93	234.48	203.13	122.08	60.92	0	0	0	0	116.5	206.18	294.45

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

312.09	252.4	218.66	131.41	65.58	0	0	0	0	125.4	221.94	316.95

Total (kWh/year) = Sum(211)_{1..5,10..12} = 1644.43 (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)

149.31	130.99	136.12	120.03	116.17	101.73	95.74	107.77	108.44	124.57	134.23	145.05

Efficiency of water heater 87.3 (216)

(217)m= 89.39 89.33 89.19 88.88 88.37 87.3 87.3 87.3 87.3 88.82 89.21 89.42 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	167.04	146.64	152.62	135.04	131.46	116.53	109.66	123.45	124.21	140.25	150.46	162.22

Total = Sum(219a)_{1..12} = 1659.58 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m ÷ (209)

(221)m=	0	0	0	0	0	4.6	5.68	4.92	0	0	0	0

Total = Sum(221)_{6..8} = 15.2 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	1644.43	
Water heating fuel used	1659.58	
Space cooling fuel used	15.2	

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 125.28 (230a)

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 200.28 (231)

Electricity for lighting 288.44 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 3807.92 (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	0.216	= 355.2 (261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	358.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =			713.67	(265)
Space cooling	(221) x	0.519	=	7.89	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	103.94	(267)
Electricity for lighting	(232) x	0.519	=	149.7	(268)
Total CO2, kg/year	sum of (265)...(271) =			975.2	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			15.73	(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: 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)	2.5 (2a)	192.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.5 (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

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.66	13.22	14.59	14.07	14.51	14	14.44	14.48	14.04	14.56	14.14	14.65	(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=	163.57	143.45	148.98	131.24	126.93	111.01	104.33	117.64	118.43	136.21	146.94	158.86	(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=	163.57	143.45	148.98	131.24	126.93	111.01	104.33	117.64	118.43	136.21	146.94	158.86	
Output from water heater (annual) _{1...12}												1607.59	(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=	53.18	46.61	48.33	42.48	41.01	35.76	33.5	37.92	38.22	44.09	47.69	51.61	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	71.47	69.36	64.96	58.99	55.12	49.66	45.03	50.97	53.08	59.26	66.24	69.37	(72)

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

(73)m=	366.99	364.8	351.45	330.04	308.37	287.55	274.08	280.09	291.16	312.78	337.54	356.05	(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)

DER WorkSheet: New dwelling design stage

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= 404.12 437.24 471.18 506.77 527.76 513.57 488.65 462.38 430.98 398.76 383.78 386.63 (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	0.53	0.74	0.9	0.96	0.98

(86)

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

(87)m= 19.39 19.57 19.88 20.31 20.66 20.89 20.97 20.95 20.79 20.35 19.81 19.36 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.28	20.28	20.28	20.29	20.29	20.3	20.3	20.31	20.3	20.29	20.29	20.28	(88)

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

(89)m=	0.97	0.96	0.93	0.87	0.75	0.58	0.42	0.46	0.7	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=	18.08	18.34	18.8	19.41	19.89	20.2	20.28	20.27	20.08	19.47	18.69	18.04	(90)

fLA = Living area ÷ (4) =	0.37	(91)

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

(92)m=	18.57	18.79	19.2	19.74	20.18	20.45	20.54	20.53	20.35	19.8	19.11	18.54	(92)

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

(93)m=	18.42	18.64	19.05	19.59	20.03	20.3	20.39	20.38	20.2	19.65	18.96	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=	0.96	0.94	0.91	0.85	0.74	0.58	0.43	0.47	0.69	0.87	0.94	0.96	(94)

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

(95)m=	385.96	411.31	429.08	429.55	390.84	297.69	208.82	216.23	297.62	346.34	359.62	371.23	(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=	842.46	817.38	743.9	622.96	483.6	325.37	215.91	225.99	350.27	525.18	693.28	835.01	(97)

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

(98)m=	339.63	272.88	234.22	139.26	69.01	0	0	0	0	133.06	240.24	345.05	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1773.34	(98)

Space heating requirement in kWh/m²/year

23.03	(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

92.9	(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)

339.63	272.88	234.22	139.26	69.01	0	0	0	0	133.06	240.24	345.05

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

365.59	293.73	252.12	149.9	74.28	0	0	0	0	143.23	258.6	371.42

Total (kWh/year) =Sum(211) _{1...5,10...12} =	1908.87	(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)

163.57	143.45	148.98	131.24	126.93	111.01	104.33	117.64	118.43	136.21	146.94	158.86

Efficiency of water heater

87.3 (216)

(217)m= 89.43 89.37 89.23 88.92 88.4 87.3 87.3 87.3 87.3 88.85 89.26 89.47 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

182.89	160.51	166.97	147.59	143.58	127.16	119.51	134.75	135.66	153.3	164.62	177.56

Total = Sum(219a)_{1...12} =

1814.11 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1908.87

Water heating fuel used

1814.11

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

155.59

(230a)

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

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

230.59 (231)

Electricity for lighting

360.31 (232)

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

4313.88 (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	0.216	=	412.32	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	391.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			804.16	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	119.68	(267)
Electricity for lighting	(232) x	0.519	=	187	(268)
Total CO2, kg/year			sum of (265)...(271) =	1110.84	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	14.43	(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-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)

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	0.77	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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.55	13.12	14.49	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	(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=	142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6	
Output from water heater (annual) _{1...12}												1405.94	(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=	46.23	40.53	42.07	37.01	35.77	31.23	29.31	33.11	33.35	38.42	41.5	44.89	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	62.14	60.32	56.54	51.41	48.07	43.38	39.4	44.51	46.32	51.64	57.64	60.33	(72)

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

(73)m=	293.59	291.81	281.34	264.57	247.77	231.39	220.63	225.7	234.21	251.16	270.62	285	(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)

DER WorkSheet: New dwelling design stage

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= 379.63 435.31 470.06 486.45 485.98 463.5 446.22 439.67 434.44 407.65 373.11 359.01 (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=	0.94	0.92	0.87	0.8	0.69	0.54	0.41	0.43	0.61	0.81	0.92	0.95

(86)

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

(87)m= 19.61 19.86 20.16 20.5 20.76 20.93 20.98 20.98 20.89 20.56 20.03 19.56 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.26	20.26	20.26	20.28	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27	(88)

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

(89)m=	0.94	0.91	0.86	0.78	0.66	0.49	0.34	0.37	0.56	0.78	0.9	0.95	(89)

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

(90)m=	18.38	18.74	19.17	19.66	20.01	20.22	20.27	20.27	20.17	19.74	19.01	18.32	(90)

fLA = Living area ÷ (4) =	0.61	(91)

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

(92)m=	19.12	19.41	19.77	20.17	20.47	20.65	20.7	20.7	20.6	20.24	19.63	19.07	(92)

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

(93)m=	18.97	19.26	19.62	20.02	20.32	20.5	20.55	20.55	20.45	20.09	19.48	18.92	(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	0.89	0.84	0.77	0.66	0.51	0.37	0.39	0.57	0.77	0.89	0.93	(94)

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

(95)m=	350.69	387.35	396.23	374.03	321.33	235.71	164.18	171.07	248.44	315.92	331.73	335	(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=	651.38	635.58	578.7	482.21	372.32	250.53	167.85	175.59	271.79	410.06	538.64	644.81	(97)

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

(98)m=	223.71	166.81	135.76	77.89	37.94	0	0	0	0	70.04	148.97	230.5	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1091.62	(98)

Space heating requirement in kWh/m²/year

19.49	(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

92.9	(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)

223.71	166.81	135.76	77.89	37.94	0	0	0	0	70.04	148.97	230.5

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

240.81	179.56	146.14	83.84	40.84	0	0	0	0	75.39	160.36	248.11

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1175.05 \quad (211)$$

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)

142.66	125.16	130.11	114.79	111.15	97.4	91.72	103.16	103.77	119.13	128.29	138.6

Efficiency of water heater

87.3 (216)

(217)m= 89.23 89.1 88.91 88.57 88.09 87.3 87.3 87.3 87.3 88.46 88.99 89.27 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

159.88	140.48	146.35	129.61	126.17	111.56	105.06	118.17	118.87	134.67	144.16	155.26

Total = Sum(219a)_{1...12} =

1590.25 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1175.05

Water heating fuel used

1590.25

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

106.75 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

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

181.75 (231)

Electricity for lighting

259.39 (232)

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

3206.43 (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	0.216	=	253.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	343.49	(264)
Space and water heating	(261) + (262) + (263) + (264) =			597.3	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	94.33	(267)
Electricity for lighting	(232) x	0.519	=	134.62	(268)
Total CO2, kg/year			sum of (265)...(271) =	826.25	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	14.75	(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-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) 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
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)

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

 (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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

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

1339.68

 (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=

43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36

 (72)

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

(73)m=

271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34

 (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 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=	349.1	397.09	422.37	428.11	420.47	398.24	384.12	383.74	386.54	369.96	342.57	330.67	(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	0.8	0.7	0.55	0.41	0.43	0.6	0.8	0.91	0.95	(86)

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

(87)m=	19.7	19.93	20.22	20.53	20.77	20.93	20.98	20.98	20.9	20.6	20.11	19.65	(87)

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

(88)m=	20.28	20.28	20.28	20.29	20.29	20.31	20.31	20.31	20.3	20.29	20.29	20.29	(88)

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

(89)m=	0.93	0.9	0.85	0.78	0.67	0.5	0.35	0.37	0.55	0.77	0.89	0.94	(89)

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

(90)m=	18.52	18.86	19.26	19.7	20.03	20.24	20.29	20.29	20.2	19.81	19.12	18.46	(90)

fLA = Living area ÷ (4) =

0.56 (91)

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

(92)m=	19.18	19.47	19.8	20.17	20.45	20.62	20.68	20.68	20.59	20.25	19.68	19.13	(92)

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

(93)m=	19.03	19.32	19.65	20.02	20.3	20.47	20.53	20.53	20.44	20.1	19.53	18.98	(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=	0.92	0.88	0.84	0.77	0.67	0.51	0.37	0.39	0.56	0.76	0.88	0.93	(94)

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

(95)m=	320.03	350.19	353.35	328.61	279.8	204.82	142.4	148.64	217.72	282.1	301.29	306.4	(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=	568.56	554.56	504.26	419.62	323.46	217.55	145.46	152.29	236.3	357.66	470.56	563.24	(97)

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

(98)m=	184.91	137.34	112.28	65.53	32.48	0	0	0	0	56.21	121.88	191.09	(98)

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

901.72

Space heating requirement in kWh/m²/year

18.03

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

92.9

Efficiency of secondary/supplementary heating system, %

0

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

Space heating requirement (calculated above)

184.91	137.34	112.28	65.53	32.48	0	0	0	0	56.21	121.88	191.09

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

199.04	147.83	120.86	70.54	34.97	0	0	0	0	60.51	131.19	205.69

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

970.63

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)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater

87.3

(217)m=

89.12	88.98	88.79	88.47	88.03	87.3	87.3	87.3	87.3	88.33	88.87	89.16

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	152.36	133.9	139.55	123.64	120.37	106.44	100.31	112.72	113.35	128.51	137.46	147.98	(219)

Total = Sum(219a)_{1...12} =

1516.61

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

970.63

Water heating fuel used

1516.61

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)
central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31 (231)
Electricity for lighting		238.63 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2896.18 (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	0.216 =	209.66 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	327.59 (264)
Space and water heating	(261) + (262) + (263) + (264) =		537.24 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	88.39 (267)
Electricity for lighting	(232) x	0.519 =	123.85 (268)
Total CO2, kg/year		sum of (265)...(271) =	749.49 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.99 (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-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) 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			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
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

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

1.78

(42)

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.53	13.11	14.48	13.98	14.42	13.93	14.37	14.4	13.95	14.46	14.03	14.52	(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=

139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28

 (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=

139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28

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

1372.89

 (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=

45.09	39.54	41.04	36.12	34.91	30.49	28.62	32.32	32.55	37.49	40.48	43.78

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

60.61	58.84	55.16	50.16	46.92	42.35	38.47	43.45	45.21	50.39	56.23	58.85

 (72)

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

(73)m=

282.69	280.92	270.8	254.65	238.53	222.8	212.49	217.46	225.67	241.99	260.71	274.49

 (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=	360.61	408.54	433.37	438.39	429.99	407.07	392.52	392.3	395.49	379.64	353.08	341.82	(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	0.43	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=	19.72	19.95	20.23	20.53	20.77	20.93	20.98	20.98	20.9	20.61	20.12	19.68	(87)

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

(88)m=	20.29	20.3	20.3	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.3	(88)

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

(89)m=	0.93	0.9	0.86	0.78	0.67	0.51	0.36	0.37	0.56	0.78	0.9	0.94	(89)

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

(90)m=	18.57	18.9	19.29	19.73	20.05	20.25	20.31	20.31	20.21	19.83	19.16	18.51	(90)

fLA = Living area ÷ (4) =

0.53

(91)

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

(92)m=	19.18	19.46	19.79	20.15	20.43	20.61	20.66	20.66	20.58	20.24	19.67	19.13	(92)

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

(93)m=	19.03	19.31	19.64	20	20.28	20.46	20.51	20.51	20.43	20.09	19.52	18.98	(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=	0.92	0.89	0.84	0.77	0.67	0.52	0.37	0.39	0.57	0.77	0.88	0.93	(94)

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

(95)m=	331.63	362.01	364.89	339.28	288.95	211.4	146.74	153.2	224.83	291.56	311.85	317.62	(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=	587.88	573.14	520.96	433.26	333.82	224.27	149.76	156.8	243.69	369.24	486.19	582.26	(97)

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

(98)m=	190.65	141.88	116.12	67.66	33.39	0	0	0	0	57.79	125.52	196.89	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 929.91 (98)

Space heating requirement in kWh/m²/year

17.55 (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) x [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 92.9 (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)

190.65	141.88	116.12	67.66	33.39	0	0	0	0	57.79	125.52	196.89

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

205.22	152.73	124.99	72.84	35.94	0	0	0	0	62.21	135.12	211.94

Total (kWh/year) =Sum(211)_{1...5,10...12} = 1000.98 (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	(215)

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

Water heating

Output from water heater (calculated above)

139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28

Efficiency of water heater 87.3 (216)

(217)m= 89.12 88.99 88.8 88.48 88.03 87.3 87.3 87.3 87.3 88.34 88.87 89.17 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	156.22	137.28	143.04	126.69	123.32	109.01	102.69	115.45	116.12	131.69	140.91	151.71	(219)

Total = Sum(219a)_{1...12} = 1554.14 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1 1000.98

Water heating fuel used 1554.14

Electricity for pumps, fans and electric keep-hot

DER WorkSheet: New dwelling design stage

mechanical ventilation - balanced, extract or positive input from outside		101.03	(230a)
central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	176.03	(231)
Electricity for lighting		253.99	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2985.14	(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	0.216	=	216.21 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	335.69 (264)
Space and water heating	(261) + (262) + (263) + (264) =			551.91 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	91.36 (267)
Electricity for lighting	(232) x	0.519	=	131.82 (268)
Total CO2, kg/year		sum of (265)...(271) =		775.08 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.62 (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-01-01

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

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)
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

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

2.34

(42)

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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.65	13.21	14.58	14.06	14.5	13.99	14.43	14.47	14.03	14.55	14.13	14.64	(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=

161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43

 (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	0

 (63)

Output from water heater

(64)m=

161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43

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

1583.44

 (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=

52.35	45.88	47.58	41.82	40.38	35.21	33	37.34	37.64	43.41	46.95	50.81

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

70.36	68.27	63.95	58.09	54.27	48.91	44.35	50.19	52.27	58.35	65.21	68.29

 (72)

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

(73)m=

356.8	354.75	341.89	321.21	300.28	280.08	266.94	272.75	283.37	304.25	328.23	346.15

 (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=	398.33	435.59	475.9	520.87	550.55	539.16	512.38	479.53	440.34	400.24	379.89	380.4	(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	0.82	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=	19.87	20.04	20.32	20.66	20.88	20.97	20.99	20.99	20.93	20.65	20.21	19.84	(87)

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

(88)m=	20.41	20.41	20.42	20.43	20.43	20.44	20.44	20.44	20.44	20.43	20.43	20.42	(88)

DER WorkSheet: New dwelling design stage

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

(89)m=	0.96	0.94	0.9	0.8	0.64	0.46	0.32	0.36	0.59	0.84	0.94	0.96	(89)

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

(90)m=	18.86	19.11	19.52	20	20.29	20.42	20.44	20.44	20.36	19.99	19.37	18.83	(90)

fLA = Living area ÷ (4) =

0.34 (91)

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

(92)m=	19.2	19.43	19.79	20.22	20.49	20.61	20.63	20.63	20.56	20.21	19.66	19.17	(92)

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

(93)m=	19.05	19.28	19.64	20.07	20.34	20.46	20.48	20.48	20.41	20.06	19.51	19.02	(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	0.64	0.46	0.33	0.36	0.59	0.82	0.92	0.95	(94)

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

(95)m=	377.06	403.09	418.96	408.69	351.9	248.22	167.23	174.45	259.73	329.1	349.85	362.58	(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=	677.88	657.85	598.68	498.19	383.45	254.26	168.34	176.18	276.27	420	555.72	669.63	(97)

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

(98)m=	223.81	171.19	133.71	64.44	23.47	0	0	0	0	67.62	148.23	228.44	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1060.94 (98)

Space heating requirement in kWh/m²/year

14.34 (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

92.9 (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)

223.81	171.19	133.71	64.44	23.47	0	0	0	0	67.62	148.23	228.44

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

240.92	184.28	143.93	69.37	25.27	0	0	0	0	72.79	159.55	245.9

Total (kWh/year) =Sum(211)_{1...5,10...12} = 1142.02 (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	(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)

161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43

Efficiency of water heater

87.3 (216)

(217)m= 89.13 89.02 88.8 88.34 87.79 87.3 87.3 87.3 87.3 88.35 88.89 89.17 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

180.7	158.68	165.23	146.33	142.43	125.29	117.78	132.77	133.64	151.86	162.79	175.43

Total = Sum(219a)_{1...12} = 1792.94 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1142.02

Water heating fuel used

1792.94

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

149.53 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 224.53 (231)

Electricity for lighting

333.97 (232)

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

3493.46 (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	0.216	=	246.68	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	387.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			633.95	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	116.53	(267)
Electricity for lighting	(232) x	0.519	=	173.33	(268)
Total CO2, kg/year			sum of (265)...(271) =	923.81	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	12.48	(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-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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.53	13.11	14.48	13.98	14.42	13.93	14.37	14.4	13.95	14.46	14.03	14.52	(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=	139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28	(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=	139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28	
Output from water heater (annual) _{1...12}												1372.89	(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=	45.09	39.54	41.04	36.12	34.91	30.49	28.62	32.32	32.55	37.49	40.48	43.78	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	60.61	58.84	55.16	50.16	46.92	42.35	38.47	43.45	45.21	50.39	56.23	58.85	(72)

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

(73)m=	282.13	280.42	270.39	254.34	238.3	222.61	212.28	217.19	225.3	241.53	260.17	273.91	(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)

DER WorkSheet: New dwelling design stage

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)

DER WorkSheet: New dwelling design stage

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=	368.48	432.26	487.71	534.57	558.53	542.35	519.85	495.28	464.8	412.22	364.54	347.16	(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=	0.94	0.89	0.83	0.72	0.57	0.42	0.31	0.33	0.52	0.76	0.9	0.95	(86)

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

(87)m=	19.82	20.09	20.41	20.72	20.89	20.98	20.99	20.99	20.95	20.7	20.22	19.77	(87)

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

(88)m=	20.32	20.32	20.32	20.33	20.34	20.35	20.35	20.35	20.34	20.34	20.33	20.33	(88)

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

(89)m=	0.93	0.88	0.81	0.69	0.54	0.38	0.26	0.29	0.48	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=	18.73	19.11	19.56	19.99	20.22	20.32	20.34	20.34	20.29	19.98	19.31	18.67	(90)

fLA = Living area ÷ (4) =

(91)

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

(92)m=	19.36	19.67	20.04	20.41	20.61	20.7	20.72	20.72	20.67	20.39	19.84	19.3	(92)

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

(93)m=	19.21	19.52	19.89	20.26	20.46	20.55	20.57	20.57	20.52	20.24	19.69	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=	0.91	0.87	0.8	0.69	0.55	0.39	0.28	0.3	0.49	0.73	0.87	0.93	(94)

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

(95)m=	336.89	375.77	389.88	367.27	305.87	213.42	144.48	150.79	226.66	300.18	317.95	321.28	(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=	573.55	560.49	511.53	425.75	327.12	218.06	145.45	152.16	237	360.18	473.63	566.93	(97)

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

(98)m=	176.08	124.13	90.5	42.11	15.81	0	0	0	0	44.64	112.09	182.76	

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)

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		92.9	(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)													
176.08	124.13	90.5	42.11	15.81	0	0	0	0	44.64	112.09	182.76		
(211)m = {[[(98)m x (204)] } x 100 ÷ (206)													(211)
189.53	133.61	97.42	45.33	17.02	0	0	0	0	48.05	120.66	196.73		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												848.35	(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

Water heating

Output from water heater (calculated above)													
139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28		
Efficiency of water heater												87.3	(216)
(217)m=	89.06	88.88	88.6	88.15	87.69	87.3	87.3	87.3	87.3	88.16	88.78	89.11	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	156.33	137.44	143.36	127.16	123.8	109.01	102.69	115.45	116.12	131.95	141.06	151.81	
Total = Sum(219a) _{1..12} =												1556.18	(219)

Annual totals

Space heating fuel used, main system 1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	</

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	183.24 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	336.13 (264)
Space and water heating	(261) + (262) + (263) + (264) =			519.38 (265)

DER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	91.36	(267)
Electricity for lighting	(232) x	0.519	=	126.67	(268)
Total CO2, kg/year		sum of (265)...(271) =		737.41	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.91	(273)
EI 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-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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

 (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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

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

1339.68

 (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=

43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36

 (72)

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

(73)m=

271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34

 (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)							
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=	349.1	397.09	422.37	428.11	420.47	398.24	384.12	383.74	386.54	369.96	342.57	330.67	(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=	0.91	0.87	0.81	0.71	0.59	0.44	0.31	0.33	0.48	0.71	0.86	0.93	(86)

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

(87)m=	20.24	20.44	20.64	20.83	20.94	20.99	21	21	20.98	20.86	20.55	20.21	(87)

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

(88)m=	20.44	20.44	20.45	20.46	20.46	20.47	20.47	20.48	20.47	20.46	20.46	20.45	(88)

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

(89)m=	0.91	0.86	0.79	0.69	0.56	0.4	0.28	0.29	0.45	0.68	0.85	0.92	(89)

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

(90)m=	19.42	19.7	19.98	20.24	20.39	20.46	20.47	20.47	20.45	20.29	19.87	19.38	(90)

fLA = Living area ÷ (4) =

0.56

(91)

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

(92)m=	19.88	20.12	20.35	20.57	20.69	20.75	20.76	20.76	20.74	20.6	20.25	19.84	(92)

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

(93)m=	19.73	19.97	20.2	20.42	20.54	20.6	20.61	20.61	20.59	20.45	20.1	19.69	(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=	0.89	0.85	0.78	0.69	0.57	0.41	0.29	0.3	0.46	0.68	0.84	0.91	(94)

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

(95)m=	312.3	335.71	330.49	294.7	238.21	163.59	110.47	115.37	177.26	252.19	287.75	300.01	(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=	452.36	439.71	397.99	327.08	249.93	165.74	110.82	115.8	180.94	278.53	370.79	446.01	(97)

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

(98)m=	104.2	69.88	50.22	23.31	8.72	0	0	0	0	19.6	59.79	108.62	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												444.34	(98)

Space heating requirement in kWh/m²/year

8.89	(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 92.9 (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)

104.2	69.88	50.22	23.31	8.72	0	0	0	0	19.6	59.79	108.62

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

112.17	75.23	54.05	25.09	9.38	0	0	0	0	21.09	64.36	116.92		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												478.3	(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)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater 87.3 (216)

(217)m= 88.66 (217)

88.66	88.46	88.2	87.85	87.54	87.3	87.3	87.3	87.3	87.76	88.33	88.72

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	153.15	134.7	140.49	124.52	121.05	106.44	100.31	112.72	113.35	129.35	138.31	148.73	
Total = Sum(219a) _{1...12} =												1523.13	(219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1 478.3

Water heating fuel used 1523.13

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)
central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31 (231)
Electricity for lighting		238.63 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2410.38 (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	0.216	= 103.31 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 329 (264)
Space and water heating	(261) + (262) + (263) + (264) =		432.31 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 88.39 (267)
Electricity for lighting	(232) x	0.519	= 123.85 (268)
Total CO2, kg/year		sum of (265)...(271) =	644.55 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.89 (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: 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

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			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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.66	13.22	14.59	14.07	14.5	13.99	14.44	14.48	14.04	14.55	14.14	14.65	(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=	162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07	(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=	162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07	
Output from water heater (annual) _{1...12}												1599.75	(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=	52.91	46.37	48.09	42.26	40.8	35.58	33.34	37.73	38.03	43.87	47.45	51.35	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	71.11	69	64.64	58.7	54.84	49.42	44.81	50.72	52.82	58.96	65.9	69.02	(72)

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

(73)m=	364.07	361.88	348.62	327.37	305.89	285.24	271.89	277.89	288.88	310.33	334.9	353.24	(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)

DER WorkSheet: New dwelling design stage

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= 441.95 490.62 516.19 523.56 517.32 492.05 472.52 467.24 466.18 450.13 427.42 420.4 (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	0.8	0.68	0.52	0.38	0.4	0.58	0.8	0.92	0.96

(86)

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

(87)m=	20.1	20.28	20.5	20.74	20.9	20.98	21	20.99	20.96	20.78	20.42	20.07

(87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.46	20.46	20.46	20.47	20.48	20.49	20.49	20.49	20.48	20.48	20.47	20.47	(88)

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

(89)m=	0.94	0.91	0.87	0.78	0.65	0.48	0.33	0.35	0.54	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=	19.23	19.49	19.8	20.14	20.35	20.46	20.48	20.48	20.44	20.2	19.7	19.2	(90)

fLA = Living area ÷ (4) =	0.4	(91)

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

(92)m=	19.58	19.81	20.08	20.38	20.57	20.67	20.69	20.69	20.65	20.43	19.99	19.55	(92)

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

(93)m=	19.43	19.66	19.93	20.23	20.42	20.52	20.54	20.54	20.5	20.28	19.84	19.4	(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	0.77	0.65	0.48	0.34	0.36	0.54	0.77	0.89	0.94	(94)

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

(95)m=	411.16	441.06	440.24	404.35	336.97	236.27	159.85	166.96	253.97	345.72	381.52	394.83	(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=	656.64	637.56	577.48	475.82	364.51	241.57	160.73	168.08	263.66	404.73	537.69	647.45	(97)

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

(98)m=	182.64	132.05	102.11	51.45	20.49	0	0	0	0	43.9	112.44	187.95	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												833.03	(98)

Space heating requirement in kWh/m²/year

10.96	(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

92.9	(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)

182.64	132.05	102.11	51.45	20.49	0	0	0	0	43.9	112.44	187.95

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

196.6	142.14	109.91	55.39	22.06	0	0	0	0	47.26	121.03	202.32

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = \quad (211)$$

896.69	(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	

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} = \quad (215)$$

0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07

Efficiency of water heater

87.3 (216)

(217)m= 88.96 88.81 88.58 88.18 87.73 87.3 87.3 87.3 87.3 88.06 88.66 89.01 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

182.95	160.73	167.37	148.1	143.98	126.55	118.95	134.11	135	153.92	164.91	177.59

Total = Sum(219a)_{1...12} =

1814.15 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

896.69

Water heating fuel used

1814.15

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

144.88 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

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

219.88 (231)

Electricity for lighting

359.27 (232)

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

3289.99 (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	0.216	=	193.69	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	391.86	(264)
Space and water heating	(261) + (262) + (263) + (264) =			585.54	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	114.12	(267)
Electricity for lighting	(232) x	0.519	=	186.46	(268)
Total CO2, kg/year			sum of (265)...(271) =	886.12	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	11.66	(273)
EI 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-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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.67	13.23	14.61	14.09	14.52	14.01	14.45	14.49	14.05	14.57	14.16	14.66	(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=	166.6	146.11	151.73	133.63	129.22	112.99	106.17	119.75	120.56	138.7	149.65	161.8	(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=	166.6	146.11	151.73	133.63	129.22	112.99	106.17	119.75	120.56	138.7	149.65	161.8	
Output from water heater (annual) _{1...12}												1636.91	(64)

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

(65)m=	54.19	47.49	49.24	43.27	41.77	36.41	34.11	38.62	38.93	44.91	48.59	52.59	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	72.83	70.67	66.19	60.1	56.14	50.57	45.85	51.91	54.07	60.37	67.49	70.68	(72)

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

(73)m=	377.77	375.65	362.03	340.06	317.75	296.26	282.32	288.34	299.64	321.82	347.3	366.41	(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)

DER WorkSheet: New dwelling design stage

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= 425.43 468.49 515.8 568.55 603.34 591.51 562.2 524.7 479.61 432.05 406.61 405.7 (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	0.75	0.59	0.46	0.5	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= 19.37 19.56 19.9 20.35 20.7 20.91 20.97 20.96 20.81 20.35 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=	20.27	20.27	20.27	20.28	20.29	20.3	20.3	20.3	20.29	20.29	20.28	20.28	(88)

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

(89)m=	0.97	0.95	0.92	0.85	0.72	0.54	0.39	0.43	0.68	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=	18.05	18.33	18.82	19.46	19.93	20.21	20.28	20.27	20.09	19.48	18.67	18.01	(90)

fLA = Living area ÷ (4) =	0.37	(91)

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

(92)m=	18.53	18.78	19.22	19.79	20.22	20.47	20.53	20.52	20.36	19.8	19.09	18.5	(92)

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

(93)m=	18.38	18.63	19.07	19.64	20.07	20.32	20.38	20.37	20.21	19.65	18.94	18.35	(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	0.71	0.54	0.4	0.44	0.67	0.86	0.94	0.96	(94)

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

(95)m=	406.31	439.6	465.95	471.96	428.68	321.83	223.23	231.29	321.3	372.34	380.67	389.66	(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, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	892.79	867.68	791.48	664.51	516.08	346.46	229.37	240.12	372.81	558.28	735.25	884.76	(97)

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

(98)m=	361.94	287.67	242.2	138.64	65.03	0	0	0	0	138.34	255.29	368.36	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1857.46	(98)

Space heating requirement in kWh/m²/year

22.93	(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

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

1	(204)

Efficiency of main space heating system 1

92.9	(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)

361.94	287.67	242.2	138.64	65.03	0	0	0	0	138.34	255.29	368.36

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

389.6	309.65	260.71	149.24	70	0	0	0	0	148.91	274.81	396.51

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

1999.42	(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	

$$\text{Total (kWh/year) = Sum(215)}_{1...5,10...12} =$$

0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

166.6	146.11	151.73	133.63	129.22	112.99	106.17	119.75	120.56	138.7	149.65	161.8

Efficiency of water heater

87.3 (216)

(217)m= 89.47 89.4 89.24 88.9 88.35 87.3 87.3 87.3 87.3 88.87 89.29 89.5 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

186.22	163.45	170.02	150.31	146.27	129.43	121.61	137.17	138.1	156.07	167.6	180.78

Total = Sum(219a)_{1...12} = 1847.03 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1999.42

Water heating fuel used

1847.03

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

163.67 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 238.67 (231)

Electricity for lighting

356.69 (232)

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

4441.81 (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	0.216	= 431.88 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 398.96 (264)
Space and water heating	(261) + (262) + (263) + (264) =		830.83 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 123.87 (267)
Electricity for lighting	(232) x	0.519	= 185.12 (268)
Total CO2, kg/year		sum of (265)...(271) =	1139.83 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.07 (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-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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.65	13.21	14.58	14.06	14.5	13.99	14.43	14.47	14.03	14.55	14.13	14.64	(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=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	(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	0	(63)

Output from water heater

(64)m=	161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43	
Output from water heater (annual) _{1...12}												1583.44	(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=	52.35	45.88	47.58	41.82	40.38	35.21	33	37.34	37.64	43.41	46.95	50.81	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	70.36	68.27	63.95	58.09	54.27	48.91	44.35	50.19	52.27	58.35	65.21	68.29	(72)

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

(73)m=	356.8	354.75	341.89	321.21	300.28	280.08	266.94	272.75	283.37	304.25	328.23	346.15	(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	=	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)

DER WorkSheet: New dwelling design stage

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= 398.33 435.59 475.9 520.87 550.55 539.16 512.38 479.53 440.34 400.24 379.89 380.4 (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	0.97

(86)

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

(87)m= 19.36 19.55 19.88 20.33 20.68 20.9 20.97 20.96 20.8 20.34 19.79 19.33 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27	(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	0.55	0.39	0.44	0.68	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=	18.02	18.3	18.78	19.42	19.91	20.19	20.26	20.26	20.07	19.45	18.65	17.99	(90)

fLA = Living area ÷ (4) =	0.34	(91)

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

(92)m=	18.48	18.72	19.16	19.73	20.17	20.43	20.5	20.5	20.32	19.76	19.04	18.44	(92)

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

(93)m=	18.33	18.57	19.01	19.58	20.02	20.28	20.35	20.35	20.17	19.61	18.89	18.29	(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	0.94	0.9	0.83	0.71	0.55	0.4	0.44	0.67	0.86	0.93	0.96	(94)

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

(95)m=	379.29	407.64	429.14	432.65	392.93	295.81	205.31	212.74	295.32	343.79	354.4	364.3	(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=	825.28	801.78	731.01	613.61	476.48	319.83	211.37	221.34	344.12	515.8	679.76	818.06	(97)

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

(98)m=	331.82	264.87	224.59	130.29	62.17	0	0	0	0	127.97	234.26	337.6	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1713.56	(98)

Space heating requirement in kWh/m²/year

23.16	(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

92.9	(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)

331.82	264.87	224.59	130.29	62.17	0	0	0	0	127.97	234.26	337.6

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

357.18	285.11	241.76	140.24	66.92	0	0	0	0	137.75	252.16	363.4

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

1844.52	(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)

161.07	141.26	146.72	129.27	125.04	109.38	102.82	115.91	116.67	134.17	144.71	156.43

Efficiency of water heater

87.3 (216)

(217)m= 89.43 89.36 89.21 88.88 88.34 87.3 87.3 87.3 87.3 88.83 89.25 89.46 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

180.11	158.08	164.47	145.44	141.55	125.29	117.78	132.77	133.64	151.03	162.13	174.86

Total = Sum(219a)_{1...12} =

1787.16 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1844.52

Water heating fuel used

1787.16

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

149.53 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

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

224.53 (231)

Electricity for lighting

333.97 (232)

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

4190.18 (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	0.216	=	398.42	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	386.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =			784.44	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	116.53	(267)
Electricity for lighting	(232) x	0.519	=	173.33	(268)
Total CO2, kg/year			sum of (265)...(271) =	1074.3	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	14.52	(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-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)	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]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	0	(47)

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

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

Water storage loss:

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

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.53	13.11	14.48	13.98	14.42	13.93	14.37	14.4	13.95	14.46	14.03	14.52	(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=	139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28	(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=	139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28	
Output from water heater (annual) _{1...12}												1372.89	(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=	45.09	39.54	41.04	36.12	34.91	30.49	28.62	32.32	32.55	37.49	40.48	43.78	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	60.61	58.84	55.16	50.16	46.92	42.35	38.47	43.45	45.21	50.39	56.23	58.85	(72)

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

(73)m=	282.13	280.42	270.39	254.34	238.3	222.61	212.28	217.19	225.3	241.53	260.17	273.91	(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	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)

DER WorkSheet: New dwelling design stage

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)

DER WorkSheet: New dwelling design stage

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=	368.48	432.26	487.71	534.57	558.53	542.35	519.85	495.28	464.8	412.22	364.54	347.16	(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	0.92	0.87	0.78	0.65	0.5	0.38	0.41	0.6	0.81	0.92	0.95	(86)

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

(87)m=	19.35	19.64	20.02	20.44	20.75	20.92	20.98	20.97	20.85	20.45	19.83	19.29	(87)

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

(88)m=	20.17	20.17	20.17	20.18	20.19	20.2	20.2	20.2	20.19	20.19	20.18	20.18	(88)

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

(89)m=	0.94	0.91	0.85	0.75	0.61	0.45	0.31	0.34	0.55	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=	17.95	18.36	18.91	19.5	19.9	20.12	20.18	20.18	20.05	19.52	18.65	17.88	(90)

fLA = Living area ÷ (4) =

0.58

 (91)

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

(92)m=	18.76	19.09	19.55	20.04	20.39	20.58	20.64	20.63	20.51	20.05	19.33	18.69	(92)

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

(93)m=	18.61	18.94	19.4	19.89	20.24	20.43	20.49	20.48	20.36	19.9	19.18	18.54	(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	0.89	0.83	0.74	0.62	0.46	0.34	0.37	0.56	0.77	0.89	0.93	(94)

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

(95)m=	340.4	383.76	405.73	395.92	344.6	251.88	174.18	181.14	260.17	319.44	324.68	323.97	(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=	681.92	667.54	611.17	513.28	397.5	267.43	178.29	186.62	288.93	433.07	565.59	675.71	(97)

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

(98)m=	254.09	190.7	152.85	84.5	39.36	0	0	0	0	84.54	173.46	261.69	

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

1241.19

 (98)

Space heating requirement in kWh/m ² /year	23.42	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system	<table><tr><td>0</td></tr></table>	0	(201)
0			

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		92.9	(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)												
254.09	190.7	152.85	84.5	39.36	0	0	0	0	84.54	173.46	261.69	
(211)m = {[[(98)m x (204)] } x 100 ÷ (206)												
273.51	205.28	164.53	90.96	42.36	0	0	0	0	91	186.72	281.69	
Total (kWh/year) = Sum(211) _{1..5,10...12} =												1336.05
(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)												
139.23	122.17	127.02	112.09	108.56	95.16	89.65	100.79	101.37	116.33	125.23	135.28	
Efficiency of water heater												87.3
(217)m=	89.34	89.22	89.02	88.65	88.13	87.3	87.3	87.3	87.3	88.62	89.13	89.38
(217)												
Fuel for water heating, kWh/month												
(219)m = (64)m x 100 ÷ (217)m												
(219)m=	155.84	136.92	142.69	126.45	123.19	109.01	102.69	115.45	116.12	131.27	140.51	151.35
Total = Sum(219a) _{1..12} =												1551.48
(219)												

Annual totals

Space heating fuel used, main system 1		1336.05	
Water heating fuel used		1551.48	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	101.03		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	176.03	(231)
Electricity for lighting		244.06	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3307.63	(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	0.216	= 288.59
Space heating (secondary)	(215) x	0.519	= 0
Water heating	(219) x	0.216	= 335.12
Space and water heating	(261) + (262) + (263) + (264) =		623.71

DER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	91.36	(267)
Electricity for lighting	(232) x	0.519	=	126.67	(268)
Total CO2, kg/year		sum of (265)...(271) =		841.74	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.88	(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: 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

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			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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.66	13.22	14.59	14.07	14.5	13.99	14.44	14.48	14.04	14.55	14.14	14.65	(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=	162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07	(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=	162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07	
Output from water heater (annual) _{1...12}												1599.75	(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=	52.91	46.37	48.09	42.26	40.8	35.58	33.34	37.73	38.03	43.87	47.45	51.35	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	71.11	69	64.64	58.7	54.84	49.42	44.81	50.72	52.82	58.96	65.9	69.02	(72)

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

(73)m=	364.07	361.88	348.62	327.37	305.89	285.24	271.89	277.89	288.88	310.33	334.9	353.24	(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)

DER WorkSheet: New dwelling design stage

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= 441.95 490.62 516.19 523.56 517.32 492.05 472.52 467.24 466.18 450.13 427.42 420.4 (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	0.85	0.76	0.63	0.46	0.33	0.35	0.53	0.76	0.9	0.95

(86)

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

(87)m= 20.3 20.47 20.65 20.84 20.95 20.99 21 21 20.98 20.87 20.58 20.28 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.51	20.52	20.52	20.53	20.53	20.55	20.55	20.55	20.54	20.53	20.53	20.52	(88)

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

(89)m=	0.93	0.9	0.84	0.74	0.6	0.43	0.3	0.32	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=	19.57	19.8	20.06	20.33	20.47	20.54	20.54	20.55	20.52	20.37	19.98	19.54	(90)

fLA = Living area ÷ (4) =	0.4	(91)

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

(92)m=	19.86	20.07	20.3	20.53	20.66	20.72	20.73	20.73	20.71	20.57	20.22	19.84	(92)

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

(93)m=	19.71	19.92	20.15	20.38	20.51	20.57	20.58	20.58	20.56	20.42	20.07	19.69	(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	0.83	0.73	0.6	0.43	0.3	0.32	0.5	0.73	0.87	0.93	(94)

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

(95)m=	406.84	433.22	427.52	384.23	311.9	212.78	142.87	149.19	230.78	328.11	373.72	391.21	(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=	594.91	576.82	521.43	427.19	325.98	214.87	143.16	149.56	235.01	363.26	485.09	585.37	(97)

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

(98)m=	139.93	96.5	69.87	30.93	10.47	0	0	0	0	26.15	80.18	144.46	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												598.5	(98)

Space heating requirement in kWh/m²/year

7.88	(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

92.9	(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)

139.93	96.5	69.87	30.93	10.47	0	0	0	0	26.15	80.18	144.46

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

150.62	103.87	75.21	33.3	11.27	0	0	0	0	28.15	86.31	155.5

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 644.24 \quad (211)$$

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)

162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07

Efficiency of water heater

87.3 (216)

(217)m= 88.75 88.56 88.3 87.9 87.54 87.3 87.3 87.3 87.3 87.8 88.41 88.8 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

183.39	161.18	167.89	148.58	144.3	126.55	118.95	134.11	135	154.38	165.39	178.01

Total = Sum(219a)_{1...12} =

1817.72 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

644.24

Water heating fuel used

1817.72

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

144.88 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

219.88 (231)

Electricity for lighting

359.27 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

3041.1 (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	0.216	=	139.16	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	392.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			531.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	114.12	(267)
Electricity for lighting	(232) x	0.519	=	186.46	(268)
Total CO2, kg/year			sum of (265)...(271) =	832.36	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	10.95	(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

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	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)

DER WorkSheet: New dwelling design stage

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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.67	13.23	14.61	14.09	14.52	14.01	14.45	14.49	14.05	14.57	14.16	14.66	(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=	166.6	146.11	151.73	133.63	129.22	112.99	106.17	119.75	120.56	138.7	149.65	161.8	(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 FGHS and/or WWHS 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=	166.6	146.11	151.73	133.63	129.22	112.99	106.17	119.75	120.56	138.7	149.65	161.8	
Output from water heater (annual) _{1...12}												1636.91	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	54.19	47.49	49.24	43.27	41.77	36.41	34.11	38.62	38.93	44.91	48.59	52.59	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	72.83	70.67	66.19	60.1	56.14	50.57	45.85	51.91	54.07	60.37	67.49	70.68	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	377.77	375.65	362.03	340.06	317.75	296.26	282.32	288.34	299.64	321.82	347.3	366.41	(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)

DER WorkSheet: New dwelling design stage

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= 425.43 468.49 515.8 568.55 603.34 591.51 562.2 524.7 479.61 432.05 406.61 405.7 (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	0.83	0.7	0.53	0.39	0.43	0.66	0.87	0.95	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.72 19.9 20.21 20.58 20.84 20.96 20.99 20.99 20.9 20.56 20.09 19.69 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.37	20.38	20.38	20.39	20.39	20.41	20.41	20.41	20.4	20.39	20.39	20.38	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.95	0.91	0.82	0.67	0.48	0.34	0.38	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=	18.62	18.89	19.33	19.86	20.2	20.37	20.4	20.4	20.3	19.85	19.17	18.58	(90)

fLA = Living area ÷ (4) =	0.37	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.02	19.26	19.65	20.13	20.44	20.59	20.62	20.61	20.52	20.11	19.51	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.87	19.11	19.5	19.98	20.29	20.44	20.47	20.46	20.37	19.96	19.36	18.84	(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	0.66	0.48	0.35	0.39	0.62	0.84	0.93	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	405.07	436.83	459.27	455.44	399.34	286.72	194.58	202.68	295.92	362.69	377.96	388.74	(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=	781.42	758.93	691.53	577.38	445.79	296.75	196.61	205.77	321.55	486.04	641.6	772.61	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	280	216.45	172.8	87.8	34.56	0	0	0	0	91.77	189.82	285.6	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1358.81	(98)

Space heating requirement in kWh/m²/year

16.78	(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

92.9	(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)

280	216.45	172.8	87.8	34.56	0	0	0	0	91.77	189.82	285.6

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

301.4	233	186.01	94.51	37.2	0	0	0	0	98.79	204.33	307.43

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1462.66 \quad (211)$$

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)

166.6	146.11	151.73	133.63	129.22	112.99	106.17	119.75	120.56	138.7	149.65	161.8

Efficiency of water heater

87.3 (216)

(217)m= 89.28 89.18 88.98 88.54 87.96 87.3 87.3 87.3 87.3 88.55 89.06 89.32 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

186.61	163.84	170.53	150.92	146.92	129.43	121.61	137.17	138.1	156.64	168.04	181.15

Total = Sum(219a)_{1...12} =

1850.95 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1462.66

Water heating fuel used

1850.95

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

163.67 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

238.67 (231)

Electricity for lighting

356.69 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

3908.97 (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	0.216	=	315.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	399.81	(264)
Space and water heating	(261) + (262) + (263) + (264) =			715.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	123.87	(267)
Electricity for lighting	(232) x	0.519	=	185.12	(268)
Total CO2, kg/year			sum of (265)...(271) =	1024.73	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	12.65	(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-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 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	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)

DER WorkSheet: New dwelling design stage

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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.58	13.15	14.52	14.01	14.45	13.95	14.4	14.43	13.98	14.49	14.07	14.57	(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=	148.23	130.04	135.14	119.17	115.36	101.03	95.08	107.02	107.68	123.68	133.26	144	(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=	148.23	130.04	135.14	119.17	115.36	101.03	95.08	107.02	107.68	123.68	133.26	144	
Output from water heater (annual) _{1...12}												1459.7	(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=	48.08	42.15	43.74	38.47	37.16	32.44	30.43	34.39	34.65	39.93	43.15	46.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	64.63	62.73	58.79	53.43	49.95	45.06	40.9	46.23	48.12	53.67	59.93	62.74	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	311.88	310.05	298.93	281.06	263.09	245.61	234.14	239.4	248.48	266.54	287.29	302.68	(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)

DER WorkSheet: New dwelling design stage

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= 391.38 453.26 511.16 564.13 593.29 577.8 552.69 523.05 485.77 429.63 384.04 369.67 (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	0.88	0.8	0.68	0.52	0.39	0.43	0.63	0.84	0.93	0.96

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.34 19.6 19.99 20.42 20.74 20.92 20.98 20.97 20.84 20.42 19.81 19.29 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.23	20.22	20.21	20.21	20.2	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.92	0.87	0.78	0.64	0.47	0.33	0.36	0.58	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=	17.95	18.34	18.88	19.49	19.92	20.15	20.21	20.2	20.06	19.5	18.64	17.89	(90)

fLA = Living area ÷ (4) =	0.43	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.56	18.89	19.36	19.9	20.27	20.48	20.54	20.53	20.4	19.9	19.15	18.5	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.41	18.74	19.21	19.75	20.12	20.33	20.39	20.38	20.25	19.75	19	18.35	(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	0.76	0.63	0.48	0.34	0.38	0.58	0.8	0.9	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	365	408.7	434.35	428.64	376.08	274.99	188.78	196.42	282.29	342.23	346.9	347.84	(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=	748.11	731.62	669.96	563.08	435.91	292.03	193.1	202.33	315.42	473.56	619.41	741.27	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	285.03	217	175.3	96.79	44.52	0	0	0	0	97.71	196.21	292.71	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1405.27	(98)

Space heating requirement in kWh/m²/year

23.04	(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

92.9	(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)

285.03	217	175.3	96.79	44.52	0	0	0	0	97.71	196.21	292.71

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

306.82	233.59	188.7	104.19	47.92	0	0	0	0	105.18	211.21	315.08

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1512.67 \quad (211)$$

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)

148.23	130.04	135.14	119.17	115.36	101.03	95.08	107.02	107.68	123.68	133.26	144

Efficiency of water heater

87.3 (216)

(217)m= 89.38 89.27 89.08 88.71 88.17 87.3 87.3 87.3 87.3 88.68 89.18 89.42 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

165.85	145.66	151.71	134.35	130.84	115.72	108.91	122.59	123.34	139.47	149.43	161.04

Total = Sum(219a)_{1...12} =

1648.92 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1512.67

Water heating fuel used

1648.92

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

116.28 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

191.28 (231)

Electricity for lighting

276.25 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

3629.12 (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	0.216	=	326.74	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	356.17	(264)
Space and water heating	(261) + (262) + (263) + (264) =			682.9	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	99.27	(267)
Electricity for lighting	(232) x	0.519	=	143.37	(268)
Total CO2, kg/year			sum of (265)...(271) =	925.55	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	15.17	(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-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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

 (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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Output from water heater (annual)_{1...12}

1339.68

 (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=

43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34

 (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 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=	349.1	397.09	422.37	428.11	420.47	398.24	384.12	383.74	386.54	369.96	342.57	330.67	(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	0.88	0.83	0.74	0.62	0.47	0.34	0.35	0.52	0.74	0.88	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.11	20.32	20.54	20.76	20.9	20.98	21	20.99	20.96	20.8	20.44	20.07	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.4	20.4	20.41	20.42	20.42	20.43	20.43	20.43	20.43	20.42	20.42	20.41	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.87	0.81	0.72	0.59	0.43	0.3	0.31	0.48	0.71	0.87	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.19	19.5	19.81	20.12	20.31	20.41	20.43	20.43	20.39	20.18	19.68	19.15	(90)

fLA = Living area ÷ (4) =

0.56

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.7	19.95	20.22	20.48	20.64	20.73	20.74	20.74	20.71	20.52	20.11	19.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.55	19.8	20.07	20.33	20.49	20.58	20.59	20.59	20.56	20.37	19.96	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=	0.9	0.86	0.8	0.71	0.6	0.44	0.31	0.32	0.49	0.71	0.85	0.91	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	315.06	340.75	338.21	305.65	250.74	174.88	118.69	123.98	188.68	261.81	292.46	302.33	(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=	481.97	469.01	425.13	350.6	268.52	178.63	119.38	124.81	194.81	298.63	396.12	475.73	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	124.18	86.19	64.67	32.37	13.23	0	0	0	0	27.39	74.63	129.01	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 551.66 (98)

Space heating requirement in kWh/m²/year

11.03 (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 92.9 (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)

124.18	86.19	64.67	32.37	13.23	0	0	0	0	27.39	74.63	129.01

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

133.67	92.78	69.61	34.84	14.24	0	0	0	0	29.48	80.34	138.87

Total (kWh/year) =Sum(211)_{1...5,10...12} = 593.83 (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	(215)

Total (kWh/year) =Sum(215)_{1...5,10...12} = 0 (215)

Water heating

Output from water heater (calculated above)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater 87.3 (216)

(217)m=	88.8	88.62	88.37	88.01	87.64	87.3	87.3	87.3	87.3	87.9	88.49	88.85	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	152.91	134.46	140.22	124.29	120.9	106.44	100.31	112.72	113.35	129.14	138.06	148.5	(219)

Total = Sum(219a)_{1...12} = 1521.3 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1 593.83

Water heating fuel used 1521.3

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)
central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31	(231)
Electricity for lighting		238.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2524.07	(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	0.216	= 128.27 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 328.6 (264)
Space and water heating	(261) + (262) + (263) + (264) =		456.87 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 88.39 (267)
Electricity for lighting	(232) x	0.519	= 123.85 (268)
Total CO2, kg/year		sum of (265)...(271) =	669.11 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.38 (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: 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

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			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)
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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.66	13.22	14.59	14.07	14.5	13.99	14.44	14.48	14.04	14.55	14.14	14.65	(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=	162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07	(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=	162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07	
Output from water heater (annual) _{1...12}												1599.75	(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=	52.91	46.37	48.09	42.26	40.8	35.58	33.34	37.73	38.03	43.87	47.45	51.35	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	71.11	69	64.64	58.7	54.84	49.42	44.81	50.72	52.82	58.96	65.9	69.02	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	364.07	361.88	348.62	327.37	305.89	285.24	271.89	277.89	288.88	310.33	334.9	353.24	(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)

DER WorkSheet: New dwelling design stage

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= 441.95 490.62 516.19 523.56 517.32 492.05 472.52 467.24 466.18 450.13 427.42 420.4 (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	0.75	0.6	0.45	0.47	0.66	0.85	0.94	0.96

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.73 19.93 20.2 20.51 20.77 20.93 20.98 20.98 20.89 20.59 20.12 19.7 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.35	20.35	20.35	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.36	20.36	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.9	0.83	0.72	0.55	0.39	0.41	0.62	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=	18.63	18.91	19.29	19.75	20.09	20.31	20.37	20.36	20.26	19.85	19.19	18.58	(90)

fLA = Living area ÷ (4) =	0.4	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.32	19.66	20.05	20.36	20.56	20.61	20.61	20.52	20.15	19.57	19.03	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.17	19.51	19.9	20.21	20.41	20.46	20.46	20.37	20	19.42	18.88	(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	0.82	0.71	0.55	0.4	0.42	0.62	0.81	0.91	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	415.36	449.07	453.9	427.6	369.85	272.65	188.91	197.04	287.78	366.1	389.43	398.23	(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=	767.13	745.98	677.13	561.92	432.98	289.71	192.65	201.7	314.93	478.03	631.35	758.61	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	261.72	199.53	166.08	96.71	46.97	0	0	0	0	83.28	174.19	268.12	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1296.59	(98)

Space heating requirement in kWh/m²/year

17.06	(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

92.9	(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)

261.72	199.53	166.08	96.71	46.97	0	0	0	0	83.28	174.19	268.12

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

281.72	214.77	178.77	104.1	50.56	0	0	0	0	89.65	187.5	288.61

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1395.68 \quad (211)$$

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)

162.76	142.74	148.25	130.6	126.31	110.48	103.84	117.08	117.86	135.55	146.21	158.07

Efficiency of water heater

87.3 (216)

(217)m= 89.25 89.14 88.96 88.63 88.14 87.3 87.3 87.3 87.3 88.49 89.01 89.29 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

182.37	160.14	166.64	147.35	143.3	126.55	118.95	134.11	135	153.18	164.26	177.04

Total = Sum(219a)_{1...12} =

1808.89 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1395.68

Water heating fuel used

1808.89

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

144.88

(230a)

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

219.88 (231)

Electricity for lighting

359.27 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

3783.71 (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	0.216	=	301.47	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	390.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =			692.19	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	114.12	(267)
Electricity for lighting	(232) x	0.519	=	186.46	(268)
Total CO2, kg/year			sum of (265)...(271) =	992.76	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	13.06	(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-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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.6	13.16	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(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=	151.44	132.85	138.04	121.7	117.78	103.11	97.02	109.24	109.93	126.31	136.12	147.11	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	151.44	132.85	138.04	121.7	117.78	103.11	97.02	109.24	109.93	126.31	136.12	147.11	
Output from water heater (annual) _{1...12}												1490.65	(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=	49.15	43.09	44.7	39.31	37.97	33.13	31.07	35.13	35.4	40.8	44.1	47.71	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	66.06	64.12	60.08	54.59	51.03	46.02	41.76	47.22	49.16	54.84	61.25	64.13	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	322.66	320.79	309.26	290.74	272.07	253.94	242.06	247.45	256.88	275.6	297.11	313.11	(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	=	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)

DER WorkSheet: New dwelling design stage

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= 370.32 413.63 463.04 519.23 557.66 549.19 521.94 483.8 436.84 385.82 356.42 352.4 (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	0.85	0.74	0.59	0.45	0.5	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= 19.09 19.31 19.7 20.21 20.61 20.87 20.96 20.94 20.74 20.21 19.57 19.05 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.95	0.91	0.83	0.7	0.53	0.38	0.42	0.66	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=	17.56	17.88	18.44	19.17	19.72	20.05	20.14	20.13	19.91	19.18	18.26	17.51	(90)

fLA = Living area ÷ (4) =	0.47	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.27	18.55	19.03	19.65	20.14	20.43	20.52	20.51	20.3	19.66	18.87	18.23	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.12	18.4	18.88	19.5	19.99	20.28	20.37	20.36	20.15	19.51	18.72	18.08	(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=	0.95	0.93	0.89	0.81	0.69	0.54	0.4	0.44	0.66	0.85	0.93	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	350.77	383.84	411.79	422	387.15	294.73	206.96	213.51	289.26	327.88	330.4	335.89	(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=	820.04	798.55	730.4	616.49	480.59	324.6	215.54	225.51	347.58	516.74	677.79	813.91	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	349.14	278.69	237.05	140.04	69.52	0	0	0	0	140.52	250.12	355.65	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1820.72	(98)

Space heating requirement in kWh/m²/year

28.45	(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

92.9	(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)

349.14	278.69	237.05	140.04	69.52	0	0	0	0	140.52	250.12	355.65

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

375.82	299.99	255.17	150.74	74.83	0	0	0	0	151.26	269.24	382.83

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1959.87 \quad (211)$$

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)

151.44	132.85	138.04	121.7	117.78	103.11	97.02	109.24	109.93	126.31	136.12	147.11

Efficiency of water heater

87.3 (216)

(217)m= 89.51 89.44 89.3 88.98 88.46 87.3 87.3 87.3 87.3 88.96 89.35 89.54 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

169.19	148.53	154.59	136.77	133.14	118.12	111.13	125.14	125.92	141.99	152.36	164.3

Total = Sum(219a)_{1...12} = 1681.16 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1959.87

Water heating fuel used

1681.16

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

122 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 197 (231)

Electricity for lighting

287.93 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

4125.96 (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	0.216 =	423.33 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	363.13 (264)
Space and water heating	(261) + (262) + (263) + (264) =		786.46 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	102.24 (267)
Electricity for lighting	(232) x	0.519 =	149.43 (268)
Total CO2, kg/year		sum of (265)...(271) =	1038.14 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	16.22 (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-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) x	2.5	(2a) =	177.5
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			177.5

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
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			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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.63	13.19	14.57	14.05	14.49	13.98	14.42	14.46	14.02	14.53	14.12	14.62	(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=	158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83	(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=	158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83	
Output from water heater (annual) _{1...12}												1557.5	(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=	51.45	45.1	46.78	41.12	39.71	34.63	32.46	36.73	37.01	42.68	46.15	49.94	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	69.16	67.11	62.87	57.11	53.37	48.1	43.63	49.36	51.4	57.37	64.1	67.13	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	346.99	344.99	332.51	312.45	292.17	272.57	259.79	265.49	275.76	296.02	319.29	336.65	(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)

DER WorkSheet: New dwelling design stage

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= 395.96 440.78 490.28 542.54 574.16 561.23 534.61 501.55 459.25 409.69 380.35 376.93 (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=	0.97	0.95	0.92	0.85	0.74	0.59	0.45	0.49	0.71	0.89	0.95	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.26 19.47 19.84 20.3 20.67 20.89 20.97 20.95 20.79 20.31 19.71 19.23 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.22	20.22	20.22	20.23	20.23	20.24	20.24	20.25	20.24	20.23	20.23	20.22	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.95	0.91	0.84	0.71	0.53	0.38	0.42	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=	17.86	18.16	18.69	19.35	19.85	20.14	20.22	20.21	20.02	19.37	18.52	17.81	(90)

fLA = Living area ÷ (4) =	0.57	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.65	18.91	19.34	19.89	20.31	20.57	20.64	20.63	20.46	19.9	19.19	18.61	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.5	18.76	19.19	19.74	20.16	20.42	20.49	20.48	20.31	19.75	19.04	18.46	(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	0.7	0.55	0.4	0.45	0.66	0.85	0.93	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	376.81	411.28	439.03	445.37	404.74	306.82	216.24	223.48	305.39	350.25	354.47	360.85	(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=	851.32	827.99	756.04	635.73	494.72	334.51	223.88	234.02	359.37	534.99	702.59	844.22	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	353.04	280.03	235.86	137.06	66.94	0	0	0	0	137.45	250.65	359.63	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1820.65	(98)

Space heating requirement in kWh/m²/year

25.64	(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

92.9	(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)

353.04	280.03	235.86	137.06	66.94	0	0	0	0	137.45	250.65	359.63

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

380.02	301.43	253.89	147.53	72.06	0	0	0	0	147.95	269.8	387.11

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1959.8 \quad (211)$$

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)

158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83

Efficiency of water heater

87.3 (216)

(217)m= 89.48 89.41 89.26 88.93 88.4 87.3 87.3 87.3 87.3 88.9 89.31 89.52 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

176.99	155.36	161.66	142.98	139.15	123.29	115.92	130.63	131.49	148.44	159.33	171.84

Total = Sum(219a)_{1...12} = 1757.07 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1959.8

Water heating fuel used

1757.07

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

135.34 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 210.34 (231)

Electricity for lighting

320.72 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

4247.94 (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	0.216 =	423.32 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	379.53 (264)
Space and water heating	(261) + (262) + (263) + (264) =		802.84 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	109.17 (267)
Electricity for lighting	(232) x	0.519 =	166.45 (268)
Total CO2, kg/year		sum of (265)...(271) =	1078.47 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	15.19 (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: 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)	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]×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
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 0.12	= 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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	(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=	135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95	
Output from water heater (annual) _{1...12}												1339.68	(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=	43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34	(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	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)

DER WorkSheet: New dwelling design stage

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=	303.91	333.5	365.26	398.18	417.51	406.94	387.8	366.71	339.37	308.3	291.02	290.26	(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	0.4	0.44	0.66	0.86	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.76	20.08	20.48	20.77	20.94	20.98	20.98	20.87	20.49	19.97	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.28	20.28	20.29	20.3	20.3	20.31	20.31	20.31	20.31	20.3	20.3	20.29	(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	0.49	0.34	0.38	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=	18.33	18.61	19.08	19.65	20.04	20.25	20.3	20.3	20.17	19.67	18.93	18.29	(90)

fLA = Living area ÷ (4) =

0.46 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.14	19.54	20.03	20.38	20.57	20.61	20.61	20.49	20.04	19.41	18.86	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	18.75	18.99	19.39	19.88	20.23	20.42	20.46	20.46	20.34	19.89	19.26	18.71	(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	0.79	0.66	0.5	0.36	0.39	0.61	0.82	0.91	0.94	(94)

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	284.91	305.5	318.83	313.99	276.32	202.06	138.91	144.48	207.27	252.79	265.43	274.1	(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=	553.78	538.19	490.73	410.84	317.92	212.98	141.5	148.11	230.21	346.45	456.37	548.54	(97)

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	200.04	156.37	127.9	69.74	30.95	0	0	0	0	69.68	137.48	204.19	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												996.35	(98)

Space heating requirement in $kWh/m^2/year$

19.93	(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 92.9 (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)

200.04	156.37	127.9	69.74	30.95	0	0	0	0	69.68	137.48	204.19

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

215.33	168.32	137.67	75.07	33.32	0	0	0	0	75.01	147.98	219.79

Total (kWh/year) = Sum(211)_{1...5,10...12} = 1072.49 (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)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater 87.3 (216)

(217)m= (217)

89.18	89.09	88.9	88.52	88	87.3	87.3	87.3	87.3	88.49	88.97	89.22

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	152.26	133.75	139.39	123.57	120.41	106.44	100.31	112.72	113.35	128.28	137.31	147.9	
Total = Sum(219a) _{1...12} =												1515.7	(219)

Annual totals

Space heating fuel used, main system 1 kWh/year 1072.49 kWh/year

DER WorkSheet: New dwelling design stage

Water heating fuel used		1515.7	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	95.31		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		170.31 (231)
Electricity for lighting		238.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2997.14	(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	0.216	=	231.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	327.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =			559.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	88.39	(267)
Electricity for lighting	(232) x	0.519	=	123.85	(268)
Total CO2, kg/year	sum of (265)...(271) =			771.29	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			15.43	(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: 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) x	2.5	(2a) =	177.5
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			177.5

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
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
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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.63	13.19	14.57	14.05	14.49	13.98	14.42	14.46	14.02	14.53	14.12	14.62	(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=	158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83	(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=	158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83	
Output from water heater (annual) _{1...12}												1557.5	(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=	51.45	45.1	46.78	41.12	39.71	34.63	32.46	36.73	37.01	42.68	46.15	49.94	(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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	69.16	67.11	62.87	57.11	53.37	48.1	43.63	49.36	51.4	57.37	64.1	67.13	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	346.99	344.99	332.51	312.45	292.17	272.57	259.79	265.49	275.76	296.02	319.29	336.65	(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)

DER WorkSheet: New dwelling design stage

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= 395.96 440.78 490.28 542.54 574.16 561.23 534.61 501.55 459.25 409.69 380.35 376.93 (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=	0.96	0.94	0.9	0.8	0.66	0.49	0.36	0.4	0.62	0.85	0.94	0.97

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.76 19.96 20.27 20.63 20.86 20.97 20.99 20.99 20.92 20.61 20.14 19.73 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.37	20.37	20.38	20.39	20.39	20.4	20.4	20.4	20.4	20.39	20.38	20.38	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.89	0.78	0.63	0.45	0.32	0.35	0.58	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=	18.68	18.97	19.41	19.93	20.23	20.37	20.4	20.39	20.31	19.9	19.23	18.64	(90)

fLA = Living area ÷ (4) =	0.57	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.29	19.53	19.9	20.33	20.59	20.71	20.73	20.73	20.66	20.3	19.74	19.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.14	19.38	19.75	20.18	20.44	20.56	20.58	20.58	20.51	20.15	19.59	19.11	(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	0.87	0.78	0.63	0.46	0.33	0.37	0.59	0.82	0.92	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	374.79	406.82	428.58	421.04	364.09	259.67	177.2	184.5	270.17	335.98	350.28	359.33	(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=	702.42	682.49	622.07	518.86	400.43	267.49	178.82	186.91	290.01	437.75	577.17	694.39	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	243.76	185.25	143.96	70.43	27.03	0	0	0	0	75.72	163.36	249.28	(98)

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1158.78	(98)

Space heating requirement in kWh/m²/year

16.32	(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

92.9	(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)

243.76	185.25	143.96	70.43	27.03	0	0	0	0	75.72	163.36	249.28

(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)

262.38	199.41	154.96	75.81	29.1	0	0	0	0	81.5	175.84	268.33

Total (kWh/year) =Sum(211) _{1...5,10...12} =	1247.34	(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	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)

158.38	138.91	144.3	127.15	123.01	107.63	101.2	114.04	114.79	131.97	142.31	153.83

Efficiency of water heater

87.3 (216)

(217)m= 89.21 89.1 88.87 88.41 87.86 87.3 87.3 87.3 87.3 88.44 88.98 89.25 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

177.53	155.9	162.37	143.81	140.01	123.29	115.92	130.63	131.49	149.22	159.93	172.35

Total = Sum(219a)_{1...12} =

1762.45 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1247.34

Water heating fuel used

1762.45

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

135.34 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

210.34 (231)

Electricity for lighting

320.72 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

3540.85 (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	0.216 =	269.42 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	380.69 (264)
Space and water heating	(261) + (262) + (263) + (264) =		650.11 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	109.17 (267)
Electricity for lighting	(232) x	0.519 =	166.45 (268)
Total CO2, kg/year		sum of (265)...(271) =	925.74 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.04 (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: 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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.51	13.09	14.47	13.97	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.51	(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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

 (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=

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Output from water heater (annual)_{1...12}

1339.68

 (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=

43.95	38.54	40.01	35.22	34.04	29.75	27.93	31.53	31.75	36.55	39.46	42.68

 (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=

3	3	3	3	3	3	3	3	3	3	3	3

 (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=

59.07	57.35	53.77	48.91	45.76	41.32	37.54	42.38	44.1	49.13	54.81	57.36

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

271.17	269.46	259.8	244.37	229	213.98	204.08	208.9	216.71	232.31	250.2	263.34

 (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	<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> (76)	24.62
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> (76)	48.16
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> (76)	79.31
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> (76)	115.67
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> (76)	141.76
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> (76)	145.12
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> (76)	138.16
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> (76)	118.68
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=	303.91	333.5	365.26	398.18	417.51	406.94	387.8	366.71	339.37	308.3	291.02	290.26	(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	0.85	0.73	0.57	0.41	0.3	0.33	0.52	0.78	0.9	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.18	20.35	20.59	20.83	20.95	20.99	21	21	20.98	20.81	20.48	20.16	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.47	20.47	20.47	20.48	20.49	20.5	20.5	20.5	20.49	20.49	20.48	20.48	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.9	0.84	0.71	0.55	0.38	0.26	0.29	0.49	0.75	0.89	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.35	19.59	19.93	20.27	20.43	20.49	20.5	20.5	20.47	20.26	19.79	19.33	(90)

fLA = Living area ÷ (4) =

0.46

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.74	19.94	20.23	20.53	20.67	20.72	20.73	20.73	20.7	20.51	20.11	19.71	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.59	19.79	20.08	20.38	20.52	20.57	20.58	20.58	20.55	20.36	19.96	19.56	(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=	0.92	0.89	0.82	0.7	0.55	0.38	0.27	0.3	0.49	0.75	0.88	0.93	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	279.82	296.47	301.33	279.91	228.78	155.64	104.36	108.97	167.23	230.02	256.5	269.86	(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=	427.91	414.88	376.65	310.77	237.59	156.94	104.56	109.28	171.26	263.03	349.82	421.9	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	110.17	79.57	56.04	22.22	6.55	0	0	0	0	24.56	67.19	113.12	(98)

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 479.43 (98)

Space heating requirement in kWh/m²/year

9.59 (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

92.9 (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)

110.17	79.57	56.04	22.22	6.55	0	0	0	0	24.56	67.19	113.12

(211)m = {[(98)m x (204)] } x 100 ÷ (206)

(211)

118.59	85.66	60.32	23.92	7.05	0	0	0	0	26.44	72.33	121.76

Total (kWh/year) =Sum(211)_{1...5,10...12} = 516.07 (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

Total (kWh/year) =Sum(215)_{1...5,10...12} = 0 (215)

Water heating

Output from water heater (calculated above)

135.78	119.15	123.91	109.38	105.96	92.92	87.57	98.4	98.96	113.52	122.16	131.95

Efficiency of water heater

87.3 (216)

(217)m=	88.7	88.55	88.27	87.82	87.48	87.3	87.3	87.3	87.3	87.85	88.41	88.75	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	153.07	134.56	140.38	124.55	121.13	106.44	100.31	112.72	113.35	129.21	138.18	148.68

Total = Sum(219a)_{1...12} = 1522.58 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

516.07

Water heating fuel used

1522.58

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)
central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	170.31 (231)
Electricity for lighting		238.63 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2447.59 (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	0.216	= 111.47 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 328.88 (264)
Space and water heating	(261) + (262) + (263) + (264) =		440.35 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 88.39 (267)
Electricity for lighting	(232) x	0.519	= 123.85 (268)
Total CO2, kg/year		sum of (265)...(271) =	652.59 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.05 (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: 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

DER WorkSheet: New dwelling design stage

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	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)
Windows Type 3			2.84	x 1/[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)

DER WorkSheet: New dwelling design stage

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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.54	13.11	14.48	13.98	14.42	13.93	14.38	14.41	13.96	14.46	14.03	14.53	(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=	140.37	123.17	128.05	113	109.43	95.91	90.34	101.58	102.17	117.27	126.26	136.39	(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=	140.37	123.17	128.05	113	109.43	95.91	90.34	101.58	102.17	117.27	126.26	136.39	
Output from water heater (annual) _{1...12}												1383.94	(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=	45.47	39.87	41.38	36.42	35.19	30.74	28.85	32.59	32.82	37.8	40.82	44.15	(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=	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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	61.12	59.33	55.62	50.58	47.31	42.7	38.78	43.8	45.59	50.8	56.7	59.34	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.9	284.17	274.01	257.73	241.44	225.53	215.05	220	228.24	244.7	263.61	277.56	(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	=	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)

DER WorkSheet: New dwelling design stage

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=

330.09	370.09	416.67	471.42	510.75	505.08	479.57	441.82	395.66	346.73	318.55	314.03

 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.96	0.95	0.91	0.83	0.71	0.56	0.43	0.47	0.69	0.88	0.95	0.97

 (86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=

19.1	19.33	19.74	20.25	20.65	20.88	20.96	20.95	20.76	20.24	19.59	19.06

 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.13	20.13	20.14	20.15	20.15	20.16	20.16	20.17	20.16	20.15	20.15	20.14	(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	0.35	0.4	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=	17.58	17.91	18.49	19.21	19.75	20.05	20.14	20.13	19.92	19.21	18.29	17.53	(90)

fLA = Living area ÷ (4) =	0.48	(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.31	18.59	19.08	19.71	20.18	20.45	20.53	20.52	20.32	19.7	18.91	18.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.16	18.44	18.93	19.56	20.03	20.3	20.38	20.37	20.17	19.55	18.76	18.11	(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	0.42	0.64	0.84	0.92	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	310.63	340.36	365.4	373.85	340.62	256.12	178.36	184.23	252.6	289.54	292.65	297.54	(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=	704.8	686.71	628.61	530.61	413.42	278.5	184.7	193.25	298.52	444.3	582.36	698.98	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	293.26	232.75	195.83	112.87	54.17	0	0	0	0	115.14	208.59	298.67	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1511.28	(98)

Space heating requirement in kWh/m²/year

27.99	(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

92.9	(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)

293.26	232.75	195.83	112.87	54.17	0	0	0	0	115.14	208.59	298.67

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

315.68	250.53	210.8	121.5	58.31	0	0	0	0	123.94	224.53	321.5

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 1626.78 \quad (211)$$

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)

140.37	123.17	128.05	113	109.43	95.91	90.34	101.58	102.17	117.27	126.26	136.39

Efficiency of water heater

87.3 (216)

(217)m= 89.44 89.37 89.21 88.87 88.33 87.3 87.3 87.3 87.3 88.86 89.27 89.47 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

156.95	137.82	143.55	127.15	123.88	109.86	103.49	116.36	117.04	131.97	141.44	152.44

Total = Sum(219a)_{1...12} =

1561.94 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1626.78

Water heating fuel used

1561.94

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

102.94 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

177.94 (231)

Electricity for lighting

248.14 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

3614.8 (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	0.216	=	351.39	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	337.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			688.77	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	92.35	(267)
Electricity for lighting	(232) x	0.519	=	128.78	(268)
Total CO2, kg/year			sum of (265)...(271) =	909.9	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	16.85	(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: 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)	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	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
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)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.73	0.73	0.72	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

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(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=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 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=	14.54	13.11	14.48	13.98	14.42	13.93	14.38	14.41	13.96	14.46	14.03	14.53	(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=	140.37	123.17	128.05	113	109.43	95.91	90.34	101.58	102.17	117.27	126.26	136.39	(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=	140.37	123.17	128.05	113	109.43	95.91	90.34	101.58	102.17	117.27	126.26	136.39	
Output from water heater (annual) _{1...12}												1383.94	(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=	45.47	39.87	41.38	36.42	35.19	30.74	28.85	32.59	32.82	37.8	40.82	44.15	(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=	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=	3	3	3	3	3	3	3	3	3	3	3	3	(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=	61.12	59.33	55.62	50.58	47.31	42.7	38.78	43.8	45.59	50.8	56.7	59.34	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	286.55	284.75	274.48	258.08	241.7	225.75	215.29	220.32	228.66	245.23	264.23	278.22	(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)

DER WorkSheet: New dwelling design stage

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=	319.02	348.27	379.08	410.64	428.67	417.14	397.5	376.84	350.32	320.6	304.72	304.92	(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	0.54	0.4	0.44	0.66	0.86	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.83	20.14	20.52	20.79	20.94	20.98	20.98	20.88	20.52	20.03	19.61	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.32	20.32	20.32	20.33	20.33	20.35	20.35	20.35	20.34	20.33	20.33	20.33	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.89	0.81	0.67	0.49	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=	18.47	18.74	19.18	19.72	20.1	20.29	20.34	20.33	20.22	19.74	19.04	18.43	(90)

fLA = Living area ÷ (4) =

0.48 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.03	19.26	19.64	20.1	20.43	20.6	20.65	20.64	20.54	20.12	19.52	19	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	18.88	19.11	19.49	19.95	20.28	20.45	20.5	20.49	20.39	19.97	19.37	18.85	(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	0.88	0.79	0.67	0.5	0.36	0.4	0.61	0.82	0.92	0.95	(94)

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	299.94	320.3	332.82	326.43	286.45	208.87	143.53	149.33	215.13	264.19	278.87	288.72	(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=	572.95	556.31	506.69	423.38	327.37	219.19	145.89	152.64	237.16	357.46	471.53	567.21	(97)

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	203.11	158.6	129.36	69.81	30.45	0	0	0	0	69.39	138.71	207.2	

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 1006.63 (98)

Space heating requirement in $kWh/m^2/year$

18.64 (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

92.9 (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)

203.11	158.6	129.36	69.81	30.45	0	0	0	0	69.39	138.71	207.2

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

218.64	170.72	139.24	75.14	32.77	0	0	0	0	74.7	149.32	223.03

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1083.56 (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)

140.37	123.17	128.05	113	109.43	95.91	90.34	101.58	102.17	117.27	126.26	136.39

Efficiency of water heater

87.3 (216)

(217)m=	89.16	89.07	88.88	88.49	87.98	87.3	87.3	87.3	87.3	88.46	88.95	89.2	(217)

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	157.43	138.28	144.08	127.69	124.38	109.86	103.49	116.36	117.04	132.56	141.95	152.9	

Total = $Sum(219a)_{1..12} =$ 1566.01 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1083.56

DER WorkSheet: New dwelling design stage

Water heating fuel used		1566.01	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	102.94		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	177.94	(231)
Electricity for lighting		259.6	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3087.11	(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	0.216	=	234.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	338.26	(264)
Space and water heating	(261) + (262) + (263) + (264) =			572.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	92.35	(267)
Electricity for lighting	(232) x	0.519	=	134.73	(268)
Total CO2, kg/year		sum of (265)...(271) =		799.39	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.8	(273)
El rating (section 14)				89	(274)