DER WorkSheet: New dwelling design stage

User Details:

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Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.9

Property Address: Flat 1

Address : Flat 1, 16, Rochester Mews, LONDON, NW1 9JB

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.44	(1a) x	2.8	(2a) =	169.23	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.44	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		169.23	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
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			
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)	0.27	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
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) =	0.21	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.27	0.26	0.25	0.23	0.22	0.2	0.2	0.19	0.21	0.22	0.23	0.24

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (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=	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	(24d)

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

(25)m=	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	(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			10.8	x1/[1/(1.2)+ 0.04] =	12.37			(27)
Windows Type 2			2.88	x1/[1/(1.2)+ 0.04] =	3.3			(27)
Windows Type 3			2.1	x1/[1/(1.2)+ 0.04] =	2.4			(27)
Floor			60.44	x 0.1 =	6.044	75	4533	(28)
Walls Type1	64.4	15.78	48.62	x 0.23 =	11.18	60	2917.2	(29)
Walls Type2	21.84	0	21.84	x 0.19 =	4.16	60	1310.4	(29)
Roof	11.05	0	11.05	x 0.13 =	1.44	9	99.45	(30)
Total area of elements, m²			157.73					(31)
Party wall			13.44	x 0 =	0	45	604.8	(32)
Party ceiling			49.39			30	1481.7	(32b)
Internal wall **			66.64			9	599.76	(32c)

** 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) = 40.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11546.31 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 191.04 (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 12.14 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 53.03 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.88	29.81	29.73	29.39	29.32	29.01	29.01	28.96	29.13	29.32	29.45	29.59	(38)

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

(39)m=	82.92	82.84	82.77	82.42	82.35	82.05	82.05	81.99	82.16	82.35	82.49	82.62	

Average = Sum(39)$_{1\ldots12}$ /12= 82.42 (39)

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

(40)m=	1.37	1.37	1.37	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.37	

Average = Sum(40)$_{1\ldots12}$ /12= 1.36 (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 — 1.99 (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 — 81.56 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	89.71	86.45	83.19	79.93	76.66	73.4	73.4	76.66	79.93	83.19	86.45	89.71	

Total = Sum(44)$_{1\ldots12}$ = 978.69 (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=	133.04	116.36	120.07	104.68	100.44	86.68	80.32	92.17	93.27	108.69	118.65	128.84	

Total = Sum(45)$_{1\ldots12}$ = 1283.22 (45)

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

(46)m=	19.96	17.45	18.01	15.7	15.07	13	12.05	13.82	13.99	16.3	17.8	19.33	(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): — 0.54 (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) — 0.32 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(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=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	35.43	30.84	32.85	30.55	30.28	28.05	28.99	30.28	30.55	32.85	33.04	35.43	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.52	156.27	162.97	144.95	140.77	124.45	119.35	132.49	133.53	151.59	161.41	174.32	(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)
FHRS	26.35	21.84	20.18	14.83	10.09	6.24	5.78	6.64	6.72	15.8	21.19	26.36	(63) (G2)

Output from water heater

(64)m=	151.08	133.47	141.74	129.1	129.64	117.21	112.5	124.78	125.76	134.7	139.18	146.86	

Output from water heater (annual)$_{1...12}$ | 1586.02 | (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=	61.13	53.66	56.17	50.22	49	43.61	41.99	46.25	46.42	52.39	55.49	59.73	(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=	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	(66)

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

(67)m=	15.52	13.78	11.21	8.49	6.34	5.36	5.79	7.52	10.09	12.82	14.96	15.95	(67)

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

(68)m=	174.05	175.86	171.31	161.62	149.39	137.89	130.21	128.41	132.96	142.65	154.88	166.37	(68)

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

(69)m=	32.97	32.97	32.97	32.97	32.97	32.97	32.97	32.97	32.97	32.97	32.97	32.97	(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=	-79.76	-79.76	-79.76	-79.76	-79.76	-79.76	-79.76	-79.76	-79.76	-79.76	-79.76	-79.76	(71)

Water heating gains (Table 5)

(72)m=	82.16	79.85	75.5	69.75	65.86	60.57	56.44	62.16	64.48	70.42	77.06	80.29	(72)

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

(73)m=	327.64	325.4	313.93	295.76	277.5	259.73	248.34	254	263.44	281.79	302.81	318.52	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest	0.9x	0.77	x	2.1	x	36.79		0.63	x	0.8	=	26.99	(79)
Southwest	0.9x	0.77	x	2.1	x	62.67		0.63	x	0.8	=	45.97	(79)
Southwest	0.9x	0.77	x	2.1	x	85.75		0.63	x	0.8	=	62.9	(79)
Southwest	0.9x	0.77	x	2.1	x	106.25		0.63	x	0.8	=	77.93	(79)
Southwest	0.9x	0.77	x	2.1	x	119.01		0.63	x	0.8	=	87.29	(79)
Southwest	0.9x	0.77	x	2.1	x	118.15		0.63	x	0.8	=	86.66	(79)
Southwest	0.9x	0.77	x	2.1	x	113.91		0.63	x	0.8	=	83.55	(79)
Southwest	0.9x	0.77	x	2.1	x	104.39		0.63	x	0.8	=	76.57	(79)
Southwest	0.9x	0.77	x	2.1	x	92.85		0.63	x	0.8	=	68.1	(79)
Southwest	0.9x	0.77	x	2.1	x	69.27		0.63	x	0.8	=	50.81	(79)
Southwest	0.9x	0.77	x	2.1	x	44.07		0.63	x	0.8	=	32.32	(79)
Southwest	0.9x	0.77	x	2.1	x	31.49		0.63	x	0.8	=	23.1	(79)
Northwest	0.9x	0.77	x	10.8	x	11.28	x	0.63	x	0.8	=	42.56	(81)
Northwest	0.9x	0.77	x	2.88	x	11.28	x	0.63	x	0.8	=	11.35	(81)
Northwest	0.9x	0.77	x	10.8	x	22.97	x	0.63	x	0.8	=	86.63	(81)
Northwest	0.9x	0.77	x	2.88	x	22.97	x	0.63	x	0.8	=	23.1	(81)
Northwest	0.9x	0.77	x	10.8	x	41.38	x	0.63	x	0.8	=	156.09	(81)
Northwest	0.9x	0.77	x	2.88	x	41.38	x	0.63	x	0.8	=	41.62	(81)
Northwest	0.9x	0.77	x	10.8	x	67.96	x	0.63	x	0.8	=	256.34	(81)
Northwest	0.9x	0.77	x	2.88	x	67.96	x	0.63	x	0.8	=	68.36	(81)
Northwest	0.9x	0.77	x	10.8	x	91.35	x	0.63	x	0.8	=	344.57	(81)
Northwest	0.9x	0.77	x	2.88	x	91.35	x	0.63	x	0.8	=	91.89	(81)
Northwest	0.9x	0.77	x	10.8	x	97.38	x	0.63	x	0.8	=	367.35	(81)
Northwest	0.9x	0.77	x	2.88	x	97.38	x	0.63	x	0.8	=	97.96	(81)
Northwest	0.9x	0.77	x	10.8	x	91.1	x	0.63	x	0.8	=	343.65	(81)
Northwest	0.9x	0.77	x	2.88	x	91.1	x	0.63	x	0.8	=	91.64	(81)
Northwest	0.9x	0.77	x	10.8	x	72.63	x	0.63	x	0.8	=	273.96	(81)
Northwest	0.9x	0.77	x	2.88	x	72.63	x	0.63	x	0.8	=	73.06	(81)
Northwest	0.9x	0.77	x	10.8	x	50.42	x	0.63	x	0.8	=	190.19	(81)
Northwest	0.9x	0.77	x	2.88	x	50.42	x	0.63	x	0.8	=	50.72	(81)
Northwest	0.9x	0.77	x	10.8	x	28.07	x	0.63	x	0.8	=	105.87	(81)
Northwest	0.9x	0.77	x	2.88	x	28.07	x	0.63	x	0.8	=	28.23	(81)
Northwest	0.9x	0.77	x	10.8	x	14.2	x	0.63	x	0.8	=	53.55	(81)
Northwest	0.9x	0.77	x	2.88	x	14.2	x	0.63	x	0.8	=	14.28	(81)
Northwest	0.9x	0.77	x	10.8	x	9.21	x	0.63	x	0.8	=	34.76	(81)
Northwest	0.9x	0.77	x	2.88	x	9.21	x	0.63	x	0.8	=	9.27	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	80.9	155.71	260.61	402.63	523.75	551.97	518.83	423.58	309.02	184.91	100.16	67.12	(83)

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

(84)m=	408.54	481.1	574.53	698.39	801.25	811.69	767.18	677.58	572.46	466.7	402.97	385.64	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.9	0.76	0.59	0.45	0.52	0.78	0.95	0.98	0.99	(86)

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

(87)m=	19.59	19.75	20.04	20.42	20.72	20.86	20.91	20.9	20.76	20.36	19.9	19.55	(87)

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

(88)m=	19.78	19.79	19.79	19.79	19.79	19.8	19.8	19.8	19.79	19.79	19.79	19.79	(88)

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

(89)m=	0.99	0.98	0.95	0.87	0.71	0.5	0.34	0.4	0.7	0.92	0.98	0.99	(89)

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

(90)m=	17.92	18.15	18.57	19.1	19.48	19.64	19.68	19.67	19.55	19.03	18.38	17.87	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

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

(92)m=	18.66	18.87	19.23	19.69	20.03	20.19	20.23	20.22	20.09	19.62	19.06	18.62	(92)

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

(93)m=	18.51	18.72	19.08	19.54	19.88	20.04	20.08	20.07	19.94	19.47	18.91	18.47	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.86	0.71	0.52	0.37	0.43	0.71	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	402.45	468.35	541.79	601.66	569.13	421.51	280.25	291.77	405.93	428.15	392.86	380.9	(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=	1178.51	1144.59	1040.99	876.8	673.81	446.31	285.39	300.91	479.81	730.77	973.93	1178.98	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	577.38	454.43	371.41	198.1	77.88	0	0	0	0	225.14	418.37	593.77	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2916.5 | (98)

Space heating requirement in kWh/m²/year | 48.25 | (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.2	(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)														
	577.38	454.43	371.41	198.1	77.88	0	0	0	0	225.14	418.37	593.77		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	619.51	487.59	398.51	212.55	83.57	0	0	0	0	241.57	448.9	637.09		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3129.29	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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	kWh/year	
Output from water heater (calculated above)	151.08	133.47	141.74	129.1	129.64	117.21	112.5	124.78	125.76	134.7	139.18	146.86		
Efficiency of water heater													80.1	(216)
(217)m=	87.9	87.69	87.16	85.93	83.61	80.1	80.1	80.1	80.1	86.13	87.45	88		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	171.88	152.21	162.61	150.25	155.04	146.33	140.45	155.78	157	156.39	159.15	166.89		
Total = Sum(219a)$_{1...12}$ =													1873.98	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3129.29	
Water heating fuel used			1873.98	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.03	(232)
Electricity generated by PVs			-971.55	(233)

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	=	675.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	404.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1080.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	142.22	(268)
Energy saving/generation technologies Item 1		0.519	=	-504.24	(269)
Total CO2, kg/year		sum of (265)…(271) =		757.62	(272)

DER WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate	(272) ÷ (4) =	12.54	(273)
EI rating (section 14)		90	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO002943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.9

Property Address: Flat 2

Address : Flat 2, 16, Rochester Mews, LONDON, NW1 9JB

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	86.98	(1a) x	2.8	(2a) =	243.54	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	86.98	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		243.54	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.08	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

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

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)	0.23	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.18	(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

0.23	0.22	0.22	0.2	0.19	0.17	0.17	0.17	0.18	0.19	0.2	0.21

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (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=	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	(24d)

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

(25)m=	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	(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			5.6	x1/[1/(1.2)+ 0.04] =	6.41			(27)
Windows Type 2			8.12	x1/[1/(1.2)+ 0.04] =	9.3			(27)
Windows Type 3			1.96	x1/[1/(1.2)+ 0.04] =	2.24			(27)
Windows Type 4			2.8	x1/[1/(1.2)+ 0.04] =	3.21			(27)
Floor			86.98	x 0.1 =	8.698001	75	6523.5	(28)
Walls Type1	81.48	20.44	61.04	x 0.23 =	14.04	60	3662.4	(29)
Walls Type2	19.88	0	19.88	x 0.19 =	3.79	60	1192.8	(29)
Roof	34.85	0	34.85	x 0.13 =	4.53	9	313.65	(30)
Total area of elements, m²			223.19					(31)
Party wall			13.44	x 0 =	0	45	604.8	(32)
Party ceiling			52.13			30	1563.9	(32b)
Internal wall **			136.64			9	1229.76	(32c)

** 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) = 54.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15090.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 173.5 (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 12.14 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 66.6 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	42.3	42.22	42.14	41.76	41.69	41.36	41.36	41.29	41.49	41.69	41.83	41.98	(38)

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

(39)m=	108.9	108.82	108.74	108.36	108.29	107.96	107.96	107.89	108.09	108.29	108.43	108.58	

Average = $Sum(39)_{1...12}$ /12= 108.36 (39)

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

(40)m=	1.25	1.25	1.25	1.25	1.25	1.24	1.24	1.24	1.24	1.25	1.25	1.25	

Average = $Sum(40)_{1...12}$ /12= 1.25 (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 2.58 (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 95.52 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	105.08	101.26	97.44	93.61	89.79	85.97	85.97	89.79	93.61	97.44	101.26	105.08	

Total = $Sum(44)_{1...12}$ = 1146.3 (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=	155.83	136.29	140.64	122.61	117.65	101.52	94.07	107.95	109.24	127.31	138.97	150.91	

Total = $Sum(45)_{1...12}$ = 1502.98 (45)

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

(46)m=	23.37	20.44	21.1	18.39	17.65	15.23	14.11	16.19	16.39	19.1	20.85	22.64	(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): 0.54 (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) 0.32 (55)

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(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=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	39.49	35.67	38.48	35.78	35.46	32.86	33.95	35.46	35.78	38.48	38.22	39.49	(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=	205.36	181.03	189.16	168.11	163.15	144.1	138.07	153.46	154.74	175.83	186.91	200.45	(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)
FHRS	30.69	24.2	21.73	15.88	11.31	7.31	6.77	7.77	7.87	16.55	23.81	31.06	(63) (G2)

Output from water heater

(64)m=	173.54	155.79	166.27	151.1	150.7	135.68	130.1	144.5	145.69	158.07	161.95	168.24	

Output from water heater (annual)$_{1...12}$ — 1841.61 (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=	69.72	61.49	64.42	57.49	56.02	49.75	47.8	52.79	53.04	59.99	63.54	68.09	(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=	129.1	129.1	129.1	129.1	129.1	129.1	129.1	129.1	129.1	129.1	129.1	129.1	(66)

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

(67)m=	20.81	18.48	15.03	11.38	8.51	7.18	7.76	10.09	13.54	17.19	20.06	21.39	(67)

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

(68)m=	233.41	235.83	229.73	216.74	200.33	184.92	174.62	172.2	178.3	191.29	207.7	223.11	(68)

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

(69)m=	35.91	35.91	35.91	35.91	35.91	35.91	35.91	35.91	35.91	35.91	35.91	35.91	(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=	-103.28	-103.28	-103.28	-103.28	-103.28	-103.28	-103.28	-103.28	-103.28	-103.28	-103.28	-103.28	(71)

Water heating gains (Table 5)

(72)m=	93.71	91.5	86.58	79.85	75.29	69.09	64.25	70.96	73.67	80.63	88.25	91.51	(72)

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

(73)m=	412.66	410.55	396.07	372.69	348.86	325.92	311.36	317.98	330.24	353.84	380.74	400.74	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	5.6	x	36.79	x	0.63	x	0.8	=	71.97	(77)
Southeast	0.9x	0.77	x	8.12	x	36.79	x	0.63	x	0.8	=	104.35	(77)
Southeast	0.9x	0.77	x	5.6	x	62.67	x	0.63	x	0.8	=	122.58	(77)
Southeast	0.9x	0.77	x	8.12	x	62.67	x	0.63	x	0.8	=	177.75	(77)
Southeast	0.9x	0.77	x	5.6	x	85.75	x	0.63	x	0.8	=	167.73	(77)
Southeast	0.9x	0.77	x	8.12	x	85.75	x	0.63	x	0.8	=	243.2	(77)
Southeast	0.9x	0.77	x	5.6	x	106.25	x	0.63	x	0.8	=	207.82	(77)
Southeast	0.9x	0.77	x	8.12	x	106.25	x	0.63	x	0.8	=	301.34	(77)
Southeast	0.9x	0.77	x	5.6	x	119.01	x	0.63	x	0.8	=	232.78	(77)
Southeast	0.9x	0.77	x	8.12	x	119.01	x	0.63	x	0.8	=	337.52	(77)
Southeast	0.9x	0.77	x	5.6	x	118.15	x	0.63	x	0.8	=	231.09	(77)
Southeast	0.9x	0.77	x	8.12	x	118.15	x	0.63	x	0.8	=	335.08	(77)
Southeast	0.9x	0.77	x	5.6	x	113.91	x	0.63	x	0.8	=	222.8	(77)
Southeast	0.9x	0.77	x	8.12	x	113.91	x	0.63	x	0.8	=	323.06	(77)
Southeast	0.9x	0.77	x	5.6	x	104.39	x	0.63	x	0.8	=	204.18	(77)
Southeast	0.9x	0.77	x	8.12	x	104.39	x	0.63	x	0.8	=	296.06	(77)
Southeast	0.9x	0.77	x	5.6	x	92.85	x	0.63	x	0.8	=	181.61	(77)
Southeast	0.9x	0.77	x	8.12	x	92.85	x	0.63	x	0.8	=	263.34	(77)
Southeast	0.9x	0.77	x	5.6	x	69.27	x	0.63	x	0.8	=	135.48	(77)
Southeast	0.9x	0.77	x	8.12	x	69.27	x	0.63	x	0.8	=	196.45	(77)
Southeast	0.9x	0.77	x	5.6	x	44.07	x	0.63	x	0.8	=	86.2	(77)
Southeast	0.9x	0.77	x	8.12	x	44.07	x	0.63	x	0.8	=	124.99	(77)
Southeast	0.9x	0.77	x	5.6	x	31.49	x	0.63	x	0.8	=	61.59	(77)
Southeast	0.9x	0.77	x	8.12	x	31.49	x	0.63	x	0.8	=	89.3	(77)
Southwest	0.9x	0.77	x	1.96	x	36.79		0.63	x	0.8	=	50.38	(79)
Southwest	0.9x	0.77	x	2.8	x	36.79		0.63	x	0.8	=	35.98	(79)
Southwest	0.9x	0.77	x	1.96	x	62.67		0.63	x	0.8	=	85.81	(79)
Southwest	0.9x	0.77	x	2.8	x	62.67		0.63	x	0.8	=	61.29	(79)
Southwest	0.9x	0.77	x	1.96	x	85.75		0.63	x	0.8	=	117.41	(79)
Southwest	0.9x	0.77	x	2.8	x	85.75		0.63	x	0.8	=	83.86	(79)
Southwest	0.9x	0.77	x	1.96	x	106.25		0.63	x	0.8	=	145.47	(79)
Southwest	0.9x	0.77	x	2.8	x	106.25		0.63	x	0.8	=	103.91	(79)
Southwest	0.9x	0.77	x	1.96	x	119.01		0.63	x	0.8	=	162.94	(79)
Southwest	0.9x	0.77	x	2.8	x	119.01		0.63	x	0.8	=	116.39	(79)
Southwest	0.9x	0.77	x	1.96	x	118.15		0.63	x	0.8	=	161.76	(79)
Southwest	0.9x	0.77	x	2.8	x	118.15		0.63	x	0.8	=	115.55	(79)
Southwest	0.9x	0.77	x	1.96	x	113.91		0.63	x	0.8	=	155.96	(79)
Southwest	0.9x	0.77	x	2.8	x	113.91		0.63	x	0.8	=	111.4	(79)
Southwest	0.9x	0.77	x	1.96	x	104.39		0.63	x	0.8	=	142.93	(79)

Southwest 0.9x	0.77	x	2.8	x	104.39		0.63	x	0.8	=	102.09	(79)
Southwest 0.9x	0.77	x	1.96	x	92.85		0.63	x	0.8	=	127.13	(79)
Southwest 0.9x	0.77	x	2.8	x	92.85		0.63	x	0.8	=	90.81	(79)
Southwest 0.9x	0.77	x	1.96	x	69.27		0.63	x	0.8	=	94.84	(79)
Southwest 0.9x	0.77	x	2.8	x	69.27		0.63	x	0.8	=	67.74	(79)
Southwest 0.9x	0.77	x	1.96	x	44.07		0.63	x	0.8	=	60.34	(79)
Southwest 0.9x	0.77	x	2.8	x	44.07		0.63	x	0.8	=	43.1	(79)
Southwest 0.9x	0.77	x	1.96	x	31.49		0.63	x	0.8	=	43.11	(79)
Southwest 0.9x	0.77	x	2.8	x	31.49		0.63	x	0.8	=	30.79	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	262.68	447.43	612.2	758.54	849.63	843.49	813.21	745.26	662.88	494.51	314.62	224.8	(83)

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

(84)m=	675.34	857.98	1008.27	1131.23	1198.5	1169.41	1124.57	1063.23	993.12	848.35	695.36	625.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.96	0.92	0.84	0.71	0.55	0.41	0.45	0.66	0.88	0.97	0.99	(86)

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

(87)m=	19.72	19.95	20.24	20.54	20.76	20.88	20.91	20.91	20.83	20.53	20.05	19.66	(87)

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

(88)m=	19.88	19.88	19.88	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.88	(88)

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

(89)m=	0.98	0.95	0.9	0.8	0.65	0.47	0.31	0.35	0.58	0.84	0.96	0.98	(89)

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

(90)m=	18.18	18.52	18.93	19.34	19.61	19.74	19.77	19.77	19.7	19.33	18.67	18.11	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	18.69	18.99	19.36	19.73	19.99	20.11	20.15	20.14	20.07	19.72	19.12	18.62	(92)

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

(93)m=	18.54	18.84	19.21	19.58	19.84	19.96	20	19.99	19.92	19.57	18.97	18.47	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.94	0.89	0.79	0.65	0.47	0.32	0.36	0.58	0.83	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	655.21	805.3	892.42	894.35	778.78	554.65	362.22	380.96	578	705.32	657.81	610.72	(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=	1550.63	1517.33	1382.24	1157.76	881.56	579.13	366.63	387.62	629.15	971.64	1287.51	1549.33	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	666.19	478.48	364.42	189.65	76.47	0	0	0	0	198.14	453.38	698.33		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													3125.07	(98)

Space heating requirement in kWh/m²/year	35.93	(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		93.2	(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)	666.19	478.48	364.42	189.65	76.47	0	0	0	0	198.14	453.38	698.33		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	714.8	513.39	391.01	203.49	82.05	0	0	0	0	212.6	486.46	749.28		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3353.08	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)	173.54	155.79	166.27	151.1	150.7	135.68	130.1	144.5	145.69	158.07	161.95	168.24		
Efficiency of water heater													80.1	(216)
(217)m=	87.91	87.49	86.77	85.42	83.24	80.1	80.1	80.1	80.1	85.42	87.3	88.04		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	197.4	178.06	191.62	176.88	181.04	169.39	162.43	180.39	181.88	185.04	185.51	191.08		
Total = Sum(219a)$_{1...12}$ =													2180.74	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3353.08	
Water heating fuel used			2180.74	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			367.49	(232)
Electricity generated by PVs			-1391.46	(233)

12a. CO_2 emissions – Individual heating systems including micro-CHP

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	724.26	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	471.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1195.3	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	190.73	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-722.17	(269)
Total CO2, kg/year			sum of (265)…(271) =		702.79	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		8.08	(273)
EI rating (section 14)					93	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO002943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.9

Property Address: Flat 3

Address : Flat 3, 16, Rochester Mews, LONDON, NW1 9JB

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.12	(1a) x	2.8	(2a) =	140.34	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.12	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	140.34	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

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

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)	0.29	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.23	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.29	0.28	0.28	0.25	0.24	0.22	0.22	0.21	0.23	0.24	0.26	0.27

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (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=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(24d)

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(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			9.2	x1/[1/(1.2)+ 0.04] =	10.53			(27)
Windows Type 2			9.72	x1/[1/(1.2)+ 0.04] =	11.13			(27)
Walls Type1	57.12	18.92	38.2	x 0.23 =	8.79	60	2292	(29)
Walls Type2	21.84	0	21.84	x 0.19 =	4.16	60	1310.4	(29)
Total area of elements, m²			78.96					(31)
Party wall			13.44	x 0 =	0	45	604.8	(32)
Party floor			50.12			40	2004.8	(32a)
Party ceiling			50.12			30	1503.6	(32b)
Internal wall **			66.64			9	599.76	(32c)

** 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) = 34.61 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8315.36 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 165.91 (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 7.02 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 41.63 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.09	25.02	24.94	24.6	24.53	24.23	24.23	24.17	24.35	24.53	24.66	24.8	(38)

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

(39)m=	66.72	66.65	66.57	66.23	66.16	65.86	65.86	65.81	65.98	66.16	66.29	66.43	

Average = Sum(39)$_{1…12}$ /12= 66.23 (39)

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

(40)m=	1.33	1.33	1.33	1.32	1.32	1.31	1.31	1.31	1.32	1.32	1.32	1.33

Average = Sum(40)1…12 /12= 1.32 (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 74.42 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.87	78.89	75.91	72.93	69.96	66.98	66.98	69.96	72.93	75.91	78.89	81.87

Total = Sum(44)1…12 = 893.08 (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=	121.4	106.18	109.57	95.52	91.66	79.09	73.29	84.1	85.11	99.19	108.27	117.57

Total = Sum(45)1…12 = 1170.96 (45)

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

(46)m=	18.21	15.93	16.44	14.33	13.75	11.86	10.99	12.62	12.77	14.88	16.24	17.64	(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): 0.54 (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) 0.32 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(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=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	32.33	28.14	29.98	27.88	27.63	25.6	26.45	27.63	27.88	29.98	30.15	32.33	(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=	163.78	143.39	149.59	133.12	129.33	114.41	109.79	121.78	122.7	139.21	148.14	159.95	(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)
FHRS	20.92	16.91	15.36	10.28	7.77	5.69	5.28	6.06	6.13	11.32	16.77	21.04	(63) (G2)

Output from water heater

(64)m=	141.84	125.58	133.25	121.89	120.59	107.78	103.5	114.71	115.58	126.86	130.38	137.87	

Output from water heater (annual)$_{1...12}$ 1479.83 (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=	56.48	49.6	51.96	46.51	45.42	40.47	39.02	42.91	43.04	48.51	51.31	55.21	(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=	84.68	84.68	84.68	84.68	84.68	84.68	84.68	84.68	84.68	84.68	84.68	84.68	(66)

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

(67)m=	13.15	11.68	9.5	7.19	5.38	4.54	4.9	6.38	8.56	10.87	12.68	13.52	(67)

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

(68)m=	147.54	149.08	145.22	137	126.64	116.89	110.38	108.85	112.71	120.92	131.29	141.03	(68)

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

(69)m=	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	(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=	-67.74	-67.74	-67.74	-67.74	-67.74	-67.74	-67.74	-67.74	-67.74	-67.74	-67.74	-67.74	(71)

Water heating gains (Table 5)

(72)m=	75.92	73.81	69.84	64.59	61.05	56.21	52.44	57.67	59.78	65.2	71.27	74.21	(72)

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

(73)m=	288.02	285.97	275.96	260.19	244.46	229.05	219.13	224.3	232.45	248.39	266.64	280.17	(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)	
Southwest	0.9x	0.77	x	9.72	x	36.79	0.63	x	0.8	=	124.91	(79)
Southwest	0.9x	0.77	x	9.72	x	62.67	0.63	x	0.8	=	212.77	(79)
Southwest	0.9x	0.77	x	9.72	x	85.75	0.63	x	0.8	=	291.12	(79)
Southwest	0.9x	0.77	x	9.72	x	106.25	0.63	x	0.8	=	360.72	(79)

Southwest	0.9x	0.77	x	9.72	x	119.01		0.63	x	0.8	=	404.03	(79)
Southwest	0.9x	0.77	x	9.72	x	118.15		0.63	x	0.8	=	401.11	(79)
Southwest	0.9x	0.77	x	9.72	x	113.91		0.63	x	0.8	=	386.71	(79)
Southwest	0.9x	0.77	x	9.72	x	104.39		0.63	x	0.8	=	354.4	(79)
Southwest	0.9x	0.77	x	9.72	x	92.85		0.63	x	0.8	=	315.23	(79)
Southwest	0.9x	0.77	x	9.72	x	69.27		0.63	x	0.8	=	235.16	(79)
Southwest	0.9x	0.77	x	9.72	x	44.07		0.63	x	0.8	=	149.62	(79)
Southwest	0.9x	0.77	x	9.72	x	31.49		0.63	x	0.8	=	106.9	(79)
Northwest	0.9x	0.77	x	9.2	x	11.28	x	0.63	x	0.8	=	36.26	(81)
Northwest	0.9x	0.77	x	9.2	x	22.97	x	0.63	x	0.8	=	73.8	(81)
Northwest	0.9x	0.77	x	9.2	x	41.38	x	0.63	x	0.8	=	132.96	(81)
Northwest	0.9x	0.77	x	9.2	x	67.96	x	0.63	x	0.8	=	218.36	(81)
Northwest	0.9x	0.77	x	9.2	x	91.35	x	0.63	x	0.8	=	293.52	(81)
Northwest	0.9x	0.77	x	9.2	x	97.38	x	0.63	x	0.8	=	312.93	(81)
Northwest	0.9x	0.77	x	9.2	x	91.1	x	0.63	x	0.8	=	292.74	(81)
Northwest	0.9x	0.77	x	9.2	x	72.63	x	0.63	x	0.8	=	233.37	(81)
Northwest	0.9x	0.77	x	9.2	x	50.42	x	0.63	x	0.8	=	162.02	(81)
Northwest	0.9x	0.77	x	9.2	x	28.07	x	0.63	x	0.8	=	90.19	(81)
Northwest	0.9x	0.77	x	9.2	x	14.2	x	0.63	x	0.8	=	45.62	(81)
Northwest	0.9x	0.77	x	9.2	x	9.21	x	0.63	x	0.8	=	29.61	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	161.17	286.57	424.09	579.08	697.55	714.04	679.45	587.77	477.24	325.35	195.23	136.51	(83)

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

(84)m=	449.19	572.54	700.05	839.27	942.02	943.08	898.58	812.07	709.69	573.74	461.88	416.67	(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=	0.97	0.94	0.87	0.75	0.59	0.43	0.32	0.36	0.58	0.83	0.95	0.98	(86)

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

(87)m=	19.68	19.94	20.27	20.6	20.81	20.89	20.91	20.91	20.84	20.53	20.03	19.62	(87)

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

(88)m=	19.82	19.82	19.82	19.82	19.83	19.83	19.83	19.83	19.83	19.83	19.82	19.82	(88)

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

(89)m=	0.96	0.92	0.85	0.71	0.53	0.36	0.24	0.28	0.5	0.79	0.93	0.97	(89)

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

(90)m=	18.08	18.45	18.92	19.36	19.6	19.69	19.71	19.71	19.65	19.29	18.6	18	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	18.88	19.2	19.6	19.99	20.21	20.29	20.31	20.31	20.25	19.91	19.32	18.81	(92)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.73	19.05	19.45	19.84	20.06	20.14	20.16	20.16	20.1	19.76	19.17	18.66		(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.96	0.91	0.84	0.71	0.54	0.38	0.26	0.3	0.52	0.79	0.92	0.96		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	429.2	523.76	588.6	595.3	509.82	355.54	232.73	244.11	368.54	453.08	427.19	401.51		(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=	962.95	942.91	861.92	724.23	552.92	365.09	234.66	247.4	395.63	606.29	799.97	960.81		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	397.11	281.67	203.35	92.83	32.06	0	0	0	0	113.99	268.4	416.12		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													1805.53	(98)
Space heating requirement in kWh/m²/year													36.02	(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		93.2	(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)														
	397.11	281.67	203.35	92.83	32.06	0	0	0	0	113.99	268.4	416.12		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	426.09	302.22	218.18	99.6	34.4	0	0	0	0	122.3	287.98	446.48		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1937.27	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)														
	141.84	125.58	133.25	121.89	120.59	107.78	103.5	114.71	115.58	126.86	130.38	137.87		
Efficiency of water heater													80.1	(216)
(217)m=	87.3	86.82	85.91	84.17	82.03	80.1	80.1	80.1	80.1	84.58	86.63	87.46		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	162.47	144.64	155.1	144.8	147	134.55	129.22	143.21	144.29	149.98	150.51	157.65		
Total = Sum(219a)$_{1...12}$ =													1763.43	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1937.27

Water heating fuel used			1763.43	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			232.3	(232)
Electricity generated by PVs			-798.65	(233)

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	=	418.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	380.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			799.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	120.56	(268)
Energy saving/generation technologies Item 1		0.519	=	-414.5	(269)
Total CO2, kg/year		sum of (265)…(271) =		544.34	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.86	(273)
EI rating (section 14)				92	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO002943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.9

Property Address: Flat 4

Address : Flat 4, 16, Rochester Mews, LONDON, NW1 9JB

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.61	(1a)	x	2.8	(2a)	=	141.71	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.61	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			141.71	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
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				
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)			0.29	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
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) =		0.23	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.29	0.28	0.28	0.25	0.24	0.21	0.21	0.21	0.23	0.24	0.25	0.27

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (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=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(24d)

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(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			16.8	x1/[1/(1.2)+ 0.04]		=	19.24			(27)
Windows Type 2			3.78	x1/[1/(1.2)+ 0.04]		=	4.33			(27)
Walls Type1	56.56	24.36	32.2	x	0.23	=	7.41	60	1932	(29)
Walls Type2	19.88	0	19.88	x	0.19	=	3.79	60	1192.8	(29)
Roof	35.7	0	35.7	x	0.13	=	4.64	9	321.3	(30)
Total area of elements, m²			112.14							(31)
Party wall			13.44	x	0	=	0	45	604.8	(32)
Party floor			50.61					40	2024.4	(32a)
Party ceiling			14.91					30	447.3	(32b)
Internal wall **			43.12					9	388.08	(32c)

** 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) = 43.73 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6910.68 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 136.55 (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 9.66 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 53.39 (37)

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

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

DER WorkSheet: New dwelling design stage

(38)m=	25.32	25.24	25.17	24.82	24.76	24.46	24.46	24.4	24.57	24.76	24.89	25.02	(38)

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

(39)m=	78.71	78.63	78.56	78.21	78.14	77.85	77.85	77.79	77.96	78.14	78.28	78.41	

Average = $Sum(39)_{1...12}$ /12= 78.21 (39)

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

(40)m=	1.56	1.55	1.55	1.55	1.54	1.54	1.54	1.54	1.54	1.54	1.55	1.55

Average = $Sum(40)_{1...12}$ /12= 1.55 (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 1.71 (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 74.77 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	82.24	79.25	76.26	73.27	70.28	67.29	67.29	70.28	73.27	76.26	79.25	82.24

Total = $Sum(44)_{1...12}$ = 897.21 (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=	121.97	106.67	110.08	95.97	92.08	79.46	73.63	84.49	85.5	99.64	108.77	118.12

Total = $Sum(45)_{1...12}$ = 1176.38 (45)

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

(46)m=	18.29	16	16.51	14.4	13.81	11.92	11.04	12.67	12.83	14.95	16.32	17.72	(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): 0.54 (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) 0.32 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(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=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	32.48	28.27	30.12	28	27.76	25.72	26.58	27.76	28	30.12	30.29	32.48	(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=	164.49	144.01	150.24	133.69	129.88	114.9	110.25	122.29	123.23	139.81	148.78	160.64	(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)
FHRS	21.86	17.21	15.6	10.85	8.31	5.72	5.3	6.08	6.16	11.53	17.24	22.13	(63) (G2)

Output from water heater

(64)m=	141.61	125.9	133.65	121.89	120.6	108.23	103.94	115.2	116.07	127.24	130.55	137.47	

Output from water heater (annual)$_{1...12}$ | 1482.35 | (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=	56.71	49.79	52.17	46.69	45.59	40.63	39.16	43.07	43.21	48.7	51.51	55.43	(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=	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	85.4	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.27	11.78	9.58	7.26	5.42	4.58	4.95	6.43	8.63	10.96	12.79	13.64	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	148.82	150.36	146.47	138.19	127.73	117.9	111.33	109.79	113.68	121.97	132.42	142.25	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	(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=	-68.32	-68.32	-68.32	-68.32	-68.32	-68.32	-68.32	-68.32	-68.32	-68.32	-68.32	-68.32	(71)
Water heating gains (Table 5)													
(72)m=	76.22	74.1	70.11	64.84	61.28	56.42	52.64	57.89	60.01	65.45	71.55	74.5	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	289.93	287.87	277.79	261.91	246.05	230.53	220.54	225.73	233.94	250	268.38	282.01	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	16.8	x	36.79	x	0.63	x	0.8	=	215.9	(77)

DER WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	x	16.8	x	62.67	x	0.63	x	0.8	=	367.75	(77)
Southeast 0.9x	0.77	x	16.8	x	85.75	x	0.63	x	0.8	=	503.18	(77)
Southeast 0.9x	0.77	x	16.8	x	106.25	x	0.63	x	0.8	=	623.46	(77)
Southeast 0.9x	0.77	x	16.8	x	119.01	x	0.63	x	0.8	=	698.33	(77)
Southeast 0.9x	0.77	x	16.8	x	118.15	x	0.63	x	0.8	=	693.28	(77)
Southeast 0.9x	0.77	x	16.8	x	113.91	x	0.63	x	0.8	=	668.39	(77)
Southeast 0.9x	0.77	x	16.8	x	104.39	x	0.63	x	0.8	=	612.54	(77)
Southeast 0.9x	0.77	x	16.8	x	92.85	x	0.63	x	0.8	=	544.83	(77)
Southeast 0.9x	0.77	x	16.8	x	69.27	x	0.63	x	0.8	=	406.45	(77)
Southeast 0.9x	0.77	x	16.8	x	44.07	x	0.63	x	0.8	=	258.6	(77)
Southeast 0.9x	0.77	x	16.8	x	31.49	x	0.63	x	0.8	=	184.76	(77)
Southwest 0.9x	0.77	x	3.78	x	36.79		0.63	x	0.8	=	97.15	(79)
Southwest 0.9x	0.77	x	3.78	x	62.67		0.63	x	0.8	=	165.49	(79)
Southwest 0.9x	0.77	x	3.78	x	85.75		0.63	x	0.8	=	226.43	(79)
Southwest 0.9x	0.77	x	3.78	x	106.25		0.63	x	0.8	=	280.56	(79)
Southwest 0.9x	0.77	x	3.78	x	119.01		0.63	x	0.8	=	314.25	(79)
Southwest 0.9x	0.77	x	3.78	x	118.15		0.63	x	0.8	=	311.97	(79)
Southwest 0.9x	0.77	x	3.78	x	113.91		0.63	x	0.8	=	300.78	(79)
Southwest 0.9x	0.77	x	3.78	x	104.39		0.63	x	0.8	=	275.64	(79)
Southwest 0.9x	0.77	x	3.78	x	92.85		0.63	x	0.8	=	245.18	(79)
Southwest 0.9x	0.77	x	3.78	x	69.27		0.63	x	0.8	=	182.9	(79)
Southwest 0.9x	0.77	x	3.78	x	44.07		0.63	x	0.8	=	116.37	(79)
Southwest 0.9x	0.77	x	3.78	x	31.49		0.63	x	0.8	=	83.14	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	313.05	533.24	729.61	904.02	1012.57	1005.25	969.17	888.18	790.01	589.35	374.96	267.91	(83)

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

(84)m=	602.98	821.11	1007.4	1165.92	1258.63	1235.78	1189.71	1113.91	1023.95	839.35	643.35	549.92	(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=	0.93	0.86	0.77	0.65	0.51	0.38	0.28	0.31	0.48	0.71	0.88	0.94	(86)

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

(87)m=	19.43	19.8	20.18	20.52	20.74	20.84	20.88	20.87	20.8	20.48	19.88	19.34	(87)

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

(88)m=	19.65	19.65	19.65	19.65	19.65	19.66	19.66	19.66	19.66	19.65	19.65	19.65	(88)

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

(89)m=	0.91	0.84	0.73	0.6	0.45	0.31	0.2	0.22	0.4	0.66	0.86	0.93	(89)

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

(90)m=	17.62	18.15	18.66	19.1	19.35	19.47	19.5	19.5	19.43	19.07	18.27	17.5	(90)

fLA = Living area ÷ (4) = 0.63 (91)

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

(92)m=	18.76	19.19	19.62	19.99	20.22	20.34	20.37	20.37	20.29	19.96	19.28	18.66	(92)

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

(93)m=	18.61	19.04	19.47	19.84	20.07	20.19	20.22	20.22	20.14	19.81	19.13	18.51	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.9	0.82	0.73	0.61	0.47	0.34	0.23	0.26	0.43	0.67	0.85	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	542.38	675.94	733.99	706.67	592.69	416.7	277.08	290.17	436.31	560.01	543.76	503.51	(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=	1126.13	1111.9	1018.92	855.93	654.4	434.87	281.85	296.83	471.03	719.55	941.98	1121.81	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	434.31	292.97	211.99	107.47	45.92	0	0	0	0	118.7	286.72	460.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1958.1 (98)

Space heating requirement in kWh/m²/year 38.69 (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		93.2	(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)													
	434.31	292.97	211.99	107.47	45.92	0	0	0	0	118.7	286.72	460.02	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	466	314.34	227.46	115.31	49.27	0	0	0	0	127.36	307.64	493.58	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2100.96 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } 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)

	141.61	125.9	133.65	121.89	120.6	108.23	103.94	115.2	116.07	127.24	130.55	137.47	
Efficiency of water heater												80.1	(216)
(217)m=	87.49	86.91	86.01	84.54	82.65	80.1	80.1	80.1	80.1	84.68	86.78	87.66	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	161.86	144.87	155.4	144.18	145.91	135.12	129.76	143.82	144.9	150.27	150.45	156.82

Total = Sum(219a)$_{1...12}$ = 1763.37 (219)

DER WorkSheet: New dwelling design stage

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2100.96	
Water heating fuel used			1763.37	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			234.31	(232)
Electricity generated by PVs			-806.88	(233)

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	=	453.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	380.89	(264)
Space and water heating	(261) + (262) + (263) + (264) =			834.7	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	121.6	(268)
Energy saving/generation technologies Item 1		0.519	=	-418.77	(269)
Total CO2, kg/year		sum of (265)…(271) =		576.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.39	(273)
EI rating (section 14)				92	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO002943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.9

Property Address: Flat 5

Address : Flat 5, 16, Rochester Mews, LONDON, NW1 9JB

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	70.74	(1a)	x	2.8	(2a)	=	198.07	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.74	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	198.07	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

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

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)	0.25	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.19	(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

0.25	0.24	0.24	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (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=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(24d)

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

(25)m=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(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			9.18	x1/[1/(1.2)+ 0.04]	=	10.51			(27)
Windows Type 2			11.88	x1/[1/(1.2)+ 0.04]	=	13.6			(27)
Windows Type 3			16.2	x1/[1/(1.2)+ 0.04]	=	18.55			(27)
Walls Type1	81.48	37.26	44.22	x 0.23	=	10.17	60	2653.2	(29)
Walls Type2	32.48	0	32.48	x 0.19	=	6.19	60	1948.8	(29)
Roof	70.74	0	70.74	x 0.13	=	9.2	9	636.66	(30)
Total area of elements, m²			184.7						(31)
Party floor			70.74				40	2829.6	(32a)
Internal wall **			73.92				9	665.28	(32c)

** 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) = 68.22 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8733.54 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 123.46 (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 9.66 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 77.88 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	34.7	34.61	34.54	34.18	34.11	33.8	33.8	33.74	33.92	34.11	34.24	34.39	(38)

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

(39)m=	112.58	112.49	112.42	112.06	111.99	111.68	111.68	111.62	111.8	111.99	112.12	112.27	

Average = $Sum(39)_{1…12}$ /12= 112.06 (39)

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

(40)m=	1.59	1.59	1.59	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.59

Average = Sum(40)$_{1…12}$ /12= 1.58 (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 2.26 (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 87.97 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	96.77	93.25	89.73	86.21	82.69	79.17	79.17	82.69	86.21	89.73	93.25	96.77

Total = Sum(44)$_{1…12}$ = 1055.64 (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=	143.5	125.51	129.51	112.91	108.34	93.49	86.63	99.41	100.6	117.24	127.98	138.97

Total = Sum(45)$_{1…12}$ = 1384.11 (45)

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

(46)m=	21.53	18.83	19.43	16.94	16.25	14.02	13	14.91	15.09	17.59	19.2	20.85	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.54 (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) 0.32 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(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=	10.04	9.07	10.04	9.72	10.04	9.72	10.04	10.04	9.72	10.04	9.72	10.04	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	38.22	33.26	35.44	32.95	32.66	30.26	31.27	32.66	32.95	35.44	35.64	38.22	(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=	191.76	167.84	174.99	155.58	151.04	133.47	127.95	142.11	143.27	162.72	173.34	187.24	(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)
FHRS	28.82	22.39	19.9	14.31	10.42	6.73	6.24	7.16	7.24	15.49	22.32	29.25	(63) (G2)

Output from water heater

(64)m=	161.8	144.45	153.99	140.2	139.54	125.69	120.58	133.83	134.91	146.08	149.92	156.83	

Output from water heater (annual)1…12 1707.82 (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=	65.3	57.3	59.96	53.56	52.22	46.43	44.66	49.25	49.46	55.88	59.24	63.8	(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=	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.74	15.76	12.82	9.7	7.25	6.12	6.62	8.6	11.54	14.66	17.11	18.24	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.02	201.08	195.88	184.8	170.82	157.67	148.89	146.83	152.03	163.11	177.09	190.24	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.32	(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=	-90.56	-90.56	-90.56	-90.56	-90.56	-90.56	-90.56	-90.56	-90.56	-90.56	-90.56	-90.56	(71)
Water heating gains (Table 5)													
(72)m=	87.77	85.28	80.59	74.38	70.19	64.48	60.02	66.2	68.7	75.1	82.28	85.75	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	364.5	362.08	349.24	328.85	308.22	288.24	275.49	281.59	292.23	312.83	336.44	354.18	(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)	
Southeast 0.9x	0.77	x	16.2	x	36.79	x	0.63	x	0.8	=	208.19	(77)
Southeast 0.9x	0.77	x	16.2	x	62.67	x	0.63	x	0.8	=	354.62	(77)
Southeast 0.9x	0.77	x	16.2	x	85.75	x	0.63	x	0.8	=	485.21	(77)
Southeast 0.9x	0.77	x	16.2	x	106.25	x	0.63	x	0.8	=	601.19	(77)

Southeast	0.9x	0.77	x	16.2	x	119.01	x	0.63	x	0.8	=	673.39	(77)
Southeast	0.9x	0.77	x	16.2	x	118.15	x	0.63	x	0.8	=	668.52	(77)
Southeast	0.9x	0.77	x	16.2	x	113.91	x	0.63	x	0.8	=	644.52	(77)
Southeast	0.9x	0.77	x	16.2	x	104.39	x	0.63	x	0.8	=	590.66	(77)
Southeast	0.9x	0.77	x	16.2	x	92.85	x	0.63	x	0.8	=	525.38	(77)
Southeast	0.9x	0.77	x	16.2	x	69.27	x	0.63	x	0.8	=	391.93	(77)
Southeast	0.9x	0.77	x	16.2	x	44.07	x	0.63	x	0.8	=	249.36	(77)
Southeast	0.9x	0.77	x	16.2	x	31.49	x	0.63	x	0.8	=	178.16	(77)
Southwest	0.9x	0.77	x	11.88	x	36.79		0.63	x	0.8	=	152.67	(79)
Southwest	0.9x	0.77	x	11.88	x	62.67		0.63	x	0.8	=	260.05	(79)
Southwest	0.9x	0.77	x	11.88	x	85.75		0.63	x	0.8	=	355.82	(79)
Southwest	0.9x	0.77	x	11.88	x	106.25		0.63	x	0.8	=	440.88	(79)
Southwest	0.9x	0.77	x	11.88	x	119.01		0.63	x	0.8	=	493.82	(79)
Southwest	0.9x	0.77	x	11.88	x	118.15		0.63	x	0.8	=	490.25	(79)
Southwest	0.9x	0.77	x	11.88	x	113.91		0.63	x	0.8	=	472.65	(79)
Southwest	0.9x	0.77	x	11.88	x	104.39		0.63	x	0.8	=	433.15	(79)
Southwest	0.9x	0.77	x	11.88	x	92.85		0.63	x	0.8	=	385.28	(79)
Southwest	0.9x	0.77	x	11.88	x	69.27		0.63	x	0.8	=	287.42	(79)
Southwest	0.9x	0.77	x	11.88	x	44.07		0.63	x	0.8	=	182.86	(79)
Southwest	0.9x	0.77	x	11.88	x	31.49		0.63	x	0.8	=	130.65	(79)
Northwest	0.9x	0.77	x	9.18	x	11.28	x	0.63	x	0.8	=	36.18	(81)
Northwest	0.9x	0.77	x	9.18	x	22.97	x	0.63	x	0.8	=	73.64	(81)
Northwest	0.9x	0.77	x	9.18	x	41.38	x	0.63	x	0.8	=	132.67	(81)
Northwest	0.9x	0.77	x	9.18	x	67.96	x	0.63	x	0.8	=	217.89	(81)
Northwest	0.9x	0.77	x	9.18	x	91.35	x	0.63	x	0.8	=	292.88	(81)
Northwest	0.9x	0.77	x	9.18	x	97.38	x	0.63	x	0.8	=	312.25	(81)
Northwest	0.9x	0.77	x	9.18	x	91.1	x	0.63	x	0.8	=	292.1	(81)
Northwest	0.9x	0.77	x	9.18	x	72.63	x	0.63	x	0.8	=	232.86	(81)
Northwest	0.9x	0.77	x	9.18	x	50.42	x	0.63	x	0.8	=	161.66	(81)
Northwest	0.9x	0.77	x	9.18	x	28.07	x	0.63	x	0.8	=	89.99	(81)
Northwest	0.9x	0.77	x	9.18	x	14.2	x	0.63	x	0.8	=	45.52	(81)
Northwest	0.9x	0.77	x	9.18	x	9.21	x	0.63	x	0.8	=	29.54	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	397.03	688.31	973.7	1259.96	1460.09	1471.01	1409.27	1256.68	1072.32	769.34	477.74	338.36	(83)

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

(84)m=	761.53	1050.39	1322.94	1588.81	1768.31	1759.24	1684.76	1538.27	1364.55	1082.17	814.18	692.55	(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	0.87	0.78	0.65	0.51	0.38	0.28	0.32	0.49	0.74	0.89	0.94	(86)

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

(87)m=	19.18	19.57	20.01	20.42	20.68	20.82	20.87	20.86	20.75	20.35	19.67	19.08	(87)

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

(88)m=	19.62	19.62	19.62	19.62	19.63	19.63	19.63	19.63	19.63	19.63	19.62	19.62	(88)

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

(89)m=	0.92	0.85	0.75	0.61	0.45	0.31	0.2	0.23	0.41	0.69	0.87	0.93	(89)

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

(90)m=	17.26	17.82	18.42	18.95	19.27	19.42	19.46	19.45	19.36	18.89	17.97	17.13	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	18.15	18.64	19.16	19.64	19.93	20.07	20.11	20.11	20.01	19.57	18.76	18.04	(92)

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

(93)m=	18	18.49	19.01	19.49	19.78	19.92	19.96	19.96	19.86	19.42	18.61	17.89	(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=	0.9	0.83	0.73	0.6	0.46	0.32	0.22	0.25	0.43	0.68	0.85	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	685.83	868.67	966.41	954.24	809.53	565.95	368.29	386.26	584.98	732.19	691.48	634.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1542.82	1528.42	1406.38	1186.2	904.97	594.27	375.7	397.04	643.44	987.64	1290.65	1537.26	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	637.6	443.35	327.34	167.01	71.01	0	0	0	0	190.05	431.4	671.7	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2939.46 (98)

Space heating requirement in kWh/m²/year 41.55 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.2	(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)													
	637.6	443.35	327.34	167.01	71.01	0	0	0	0	190.05	431.4	671.7	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	684.12	475.69	351.22	179.2	76.19	0	0	0	0	203.92	462.88	720.71	

Total (kWh/year) =Sum(211)1...5,10...12= 3153.92 (211)

DER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } 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)

	161.8	144.45	153.99	140.2	139.54	125.69	120.58	133.83	134.91	146.08	149.92	156.83		
Efficiency of water heater													80.1	(216)
(217)m=	87.96	87.49	86.7	85.29	83.24	80.1	80.1	80.1	80.1	85.51	87.36	88.1		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	183.95	165.11	177.61	164.38	167.62	156.91	150.54	167.08	168.43	170.83	171.61	178.01		
								Total = Sum(219a)$_{1...12}$ =					2022.09	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3153.92	
Water heating fuel used			2022.09	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			313.34	(232)
Electricity generated by PVs			-1136.22	(233)

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	=	681.25	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	436.77	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1118.02	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	162.62	(268)
Energy saving/generation technologies Item 1		0.519	=	-589.7	(269)
Total CO2, kg/year		sum of (265)…(271) =		729.87	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.32	(273)
EI rating (section 14)				92	(274)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

16 Rochester Mews

As designed

Date: Tue Oct 07 10:57:10 2014

Administrative information

Building Details

Address: Workshop Premises, 16 Rochester Mews, LONDON, NW1 9JB

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.d.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.2.0

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Palmhurst Group

Telephone number:

Address: , ,

Certifier details

Name: Neil Ingham

Telephone number: 07736 771584

Address: 7 Rosemary Way, Cleethorpes, DN35 0SR

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	14
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	8.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.23	0.23	Workshop - Zone 1_W_6
Floor	0.25	0.2	0.2	Workshop - Zone 1_S_3
Roof	0.25	0.13	0.13	Workshop - Zone 1_R_5
Windows***, roof windows, and rooflights	2.2	1.25	1.25	Workshop - Zone 1_G_7
Personnel doors	2.2	1	1	Workshop - Zone 1_D_11
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs.
Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Gas heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	0.65	-	-
Standard value	0.86	N/A	0.55	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

1- PoU

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Workshop - Zone 1	0.6	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W] Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Workshop - Zone 1	76	-	-	1295

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Workshop - Zone 1	YES (+53.6%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	213.9	213.9
External area [m²]	447.4	447.4
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	7
Average conductance [W/K]	170.35	150.88
Average U-value [W/m²K]	0.38	0.34
Alpha value* [%]	16.66	55.42

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	15.95	21.14
Cooling	0	0
Auxiliary	3.19	2.13
Lighting	4.36	15.31
Hot water	1.65	1.91
Equipment*	17.75	17.75
TOTAL**	**25.15**	**40.49**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	161.33	84.34
Primary energy* [kWh/m²]	47.7	80.1
Total emissions [kg/m²]	8.2	14

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Flued radiant heater, [HS] Unitary radiant heater, [HFT] Natural Gas, [CFT] Natural Gas										
	Actual	39.5	121.8	15.9	0	3.2	0.69	0	0.86	0
	Notional	65.4	18.9	21.1	0	2.1	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.23	Workshop - Zone 1_W_6
Floor	0.2	0.2	Workshop - Zone 1_S_3
Roof	0.15	0.13	Workshop - Zone 1_R_5
Windows, roof windows, and rooflights	1.5	1.25	Workshop - Zone 1_G_7
Personnel doors	1.5	1	Workshop - Zone 1_D_11
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	3